
Recovery Plan for the Northern Spotted Owl - DRAFT

April, 1992

Manuel Lujan Jr.
Secretary of the Interior

Donald R. Knowles
Secretary's Representative, Team Coordinator

John Turner
Director, Fish and Wildlife Service

Marvin Plenert
Regional Director, Pacific Region, and Team Leader

Jonathan Bart, *Chairman*;
Robert G. Anthony; Melvin Berg; John H. Beuter;
Wayne Elmore; John Fay; R.J. Gutiérrez; H. Theodore Heintz, Jr.;
Richard S. Holthausen; Kenneth Lathrop; Kent Mays; Richard Nafziger;
Martha Pagel; Christine Sproul; Edward E. Starkey; John C. Tappeiner.

Team Support: Charles Bruce; Phillip Carroll; Susan Earnst; Catherine Elliott;
Lawrence Finfer; Gordon Gould; Ann Hanus; David Hays;
David Johnson; Linda Kucera; Cay Ogden; Josefa O'Malley;
Craig Partridge; Nancy Pollot; Fred Seavey; Raul Tuazon.

This recovery plan is not intended to provide precise details on all aspects of northern spotted owl management. The recovery plan outlines steps necessary to bring about recovery of the species. The recovery plan is not a "decision document" as defined by the National Environmental Policy Act (NEPA). It does not allocate resources on public lands. The implementation of the recovery plan is the responsibility of federal and state management agencies in areas where the species occurs. Implementation is done through incorporation of appropriate portions of the recovery plan in agency decision documents such as forest plans, park management plans, and state game management plans. Such documents are then subject to the NEPA process of public review and selection of alternatives.

Contents

Executive Summary	vii
I. Introduction	1
A. The Northern Spotted Owl and the Endangered Species Act	3
B. The Interagency Scientific Committee	6
C. The Biological Basis of the Plan	6
D. The Means of Achieving Recovery	7
E. Sources of Information	7
F. Acknowledgements	8
II. Biology and Management of the Northern Spotted Owl	9
A. Natural History of the Northern Spotted Owl	11
1. Introduction	11
2. Natural History	11
3. Life History	26
4. Conclusion	30
B. Status and Threats	31
1. Habitat Status	31
2. Population Status	33
3. Significant Threats to the Northern Spotted Owl	33
4. Threats by Province within Washington	41
5. Threats by Province within Oregon	48
6. Threats by Province within California	57
C. Current Management	65
1. Forest Service	65
2. Bureau of Land Management	69
3. National Park Service	74
4. Fish and Wildlife Service	75
5. State of California	79
6. State of Oregon	83
7. State of Washington	86
8. Indian Land	89
III. Recovery	93
A. Recovery Objective and Delisting Criteria	95
B. Principles Followed in Developing the Plan	99
1. Strategic Principles	99
2. Biological Principles	100
3. Integration of Strategic and Biological Principles	103
C. The Recovery Plan	105
1. Overview	105
2. Management Guidelines for Federal lands	107

3. Implementation	127
4. Recovery Goals and Strategies for Each Province	141
5. Coordination	199
6. Monitoring and Research	201
IV. Implementation Schedule	209
V. Consideration of Other Species	219
A. The List of Species Considered	221
B. Benefits of the Plan to Other Species	223
C. Further Surveys, Inventory, and Research	225
VI. Literature Cited	229
Appendices	
A. Recommendations for Population Monitoring	247
B. Suitable Habitat for Northern Spotted Owls: An Update	281
C. Demographic Analysis of Northern Spotted Owl Populations	319
D. Consideration of Other Species and Ecosystem Concerns	329
E. Preparation of DCA Management Plans	413
F. Forest Protection Guidelines for the Northern Spotted Owl	419
G. Managing Stands for Northern Spotted Owl Habitat	481
H. Economics and Social Considerations in the Formulation of the Northern Spotted Owl Recovery Plan	527
I. Evaluation of Alternatives for Achieving Recovery	585
J. Designated Conservation Areas (Size of the Areas and Numbers of Northern Spotted Owls)	601
K. Recovery Team Members and Activities	625
L. Glossary	643

List of Tables

Table 2.1 Median annual home range areas (in acres) of spotted owl pairs in different study areas and physiographic provinces	23
Table 2.2 Median amounts of old-growth and mature forest (in acres) in annual pair home ranges of spotted owls, by state and physiographic province	24
Table 2.3 Estimated spotted owl habitat and number of pairs of spotted owls located during a 5-year period on all lands in Washington, Oregon, and California	34
Table 2.4 Significant threats to the owl, by physiographic province	36
Table 2.5 Results of surveys for spotted owls, great horned owls, and barred owls in the range of the northern spotted owl	38
Table 2.6 Estimated acres of spotted owl habitat on BLM lands in Oregon, California, and Washington	69
Table 3.1 Live tree densities in example old-growth western hemlock/ Douglas-fir stand prior to stand-replacing fire	115
Table 3.2 Density of residual habitat areas	120
Table 3.3 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Olympic Peninsula province	145

Table 3.4 Summary comments on the designated conservation area (DCA) network in the Olympic Peninsula province	145
Table 3.5 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Washington lowlands province	149
Table 3.6 Summary comments on the designated conservation area (DCA) network in the western Washington lowlands province	149
Table 3.7 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Washington Cascades province	153
Table 3.8 Summary comments on the designated conservation area (DCA) network in the western Washington Cascades province	154
Table 3.9 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the eastern Washington Cascades province	158
Table 3.10 Summary comments on the designated conservation area (DCA) network in the eastern Washington Cascade province.....	159
Table 3.11 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Oregon Coast Range province	163
Table 3.12 Summary comments on the designated conservation area (DCA) network in the Oregon Coast Range province	164
Table 3.13 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Oregon Cascades province	169
Table 3.14 Summary comments on the designated conservation area (DCA) network in the western Oregon Cascades province.....	170
Table 3.15 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the eastern Oregon Cascade province	173
Table 3.16 Summary comments on the designated conservation area (DCA) network in the eastern Oregon Cascades province	174
Table 3.17 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Oregon Klamath province	176
Table 3.18 Summary comments on the designated conservation area (DCA) network in the Oregon Klamath province	177
Table 3.19 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California coast province	180
Table 3.20 Summary comments on the designated conservation area (DCA) network in the California Coast province	181
Table 3.21 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California Klamath province	188
Table 3.22 Summary comments on the designated conservation area (DCA) network in the California Klamath province	189
Table 3.23 Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California Cascades province.....	195
Table 3.24 Summary comments on the designated conservation area (DCA) network in the California Cascades province	196

Table 4.1 Abbreviated cost table	214
Table 4.2 Implementation schedule	215
Table 5.1 Summary of 361 plants and animals considered in the recovery planning process for the northern spotted owl	222
Table 5.2 Numbers of other species locations and miles of streams (with fish stocks at risk) in designated conservation areas (DCAs) for the northern spotted owl summarized by physiographic province	224

List of Figures

Figure ES.1 Total acres in the range of the northern stopped owl and in DCAs within the range	ix
Figure ES.2 Total known owl pairs rangewide and in DCAs	ix
Figure 2.1 Distribution of known spotted owl pairs located in Washington, Oregon, and California between 1986 and 1990	13
Figure 2.2 Physiographic provinces within the range of the northern spotted owl in the United States	32
Figure 2.3 Demographic study areas	39
Figure 2.4a Land base and suitable habitat, Oregon Coast Range	49
Figure 2.4b Trend in northern spotted owl habitat, Oregon Coast Range province	50
Figure 2.5a Land base and suitable habitat, western Oregon Cascades	52
Figure 2.5b Trend in northern spotted owl habitat, western Oregon Cascades province	53
Figure 2.6a Land base and suitable habitat, Oregon Klamath province	57
Figure 2.6b Trend in northern spotted owl habitat, Klamath province (Oregon portion)	58
Figure 3.1 Total known owl pairs in the Washington provinces and in DCAs within the provinces	109
Figure 3.2 Acres in the Washington provinces and in DCAs within the provinces	109
Figure 3.3 Total known owl pairs in the Oregon provinces and in DCAs within the provinces	110
Figure 3.4 Acres in the Oregon provinces and in DCAs within the provinces	110
Figure 3.5 Total known owl pairs in the California provinces and in DCAs within the provinces	111
Figure 3.6 Acres in the California provinces and in DCAs within the provinces	111
Figure 3.7 Known owl pairs in the Olympic Peninsula province and in DCAs within the province	147
Figure 3.8 Acres in the Olympic Peninsula province and in DCAs within the province	147
Figure 3.9 Known owl pairs in the western Washington lowlands province and in DCAs within the province	150

Figure 3.10 Acres in the western Washington lowlands province and in DCAs within the province	150
Figure 3.11 Known owl pairs in the western Washington Cascades province and in DCAs within the province	155
Figure 3.12 Acres in the western Washington Cascades province and in DCAs within the province	155
Figure 3.13 Known owl pairs in the eastern Washington Cascades province and in DCAs within the province	160
Figure 3.14 Acres in the eastern Washington Cascades province and in DCAs within the province	160
Figure 3.15 Known owl pairs in the Oregon Coast province and in DCAs within the province	165
Figure 3.16 Acres in the Oregon Coast province and in DCAs within the province	165
Figure 3.17 Known owl pairs in the western Oregon Cascades province and in DCAs within the province	171
Figure 3.18 Acres in the western Oregon Cascades province and in DCAs within the province	171
Figure 3.19 Known owl pairs in the eastern Oregon Cascades province and in DCAs within the province	175
Figure 3.20 Acres in the eastern Oregon Cascades province and in DCAs within the province	175
Figure 3.21 Known owl pairs in the Oregon Klamath province and in DCAs within the province	178
Figure 3.22 Acres in the Oregon Klamath province and in DCAs within the province	178
Figure 3.23 Known owl pairs in the California coast province and in DCAs within the province	182
Figure 3.24 Acres in the California coast province and in DCAs within the province	182
Figure 3.25 Known owl pairs in the California Klamath province and in DCAs within the province	190
Figure 3.26 Acres in the California Klamath province and in DCAs within the province	190
Figure 3.27 Known owl pairs in the California Cascades province and in DCAs within the province	197
Figure 3.28 Acres in the California Cascades province and in DCAs within the province	197

List of Maps *(Attachments to the Northern Spotted Owl Draft Recovery Plan)*

- Map 1. Designated conservation areas - State of Washington
- Map 2. Designated conservation areas - State of Oregon
- Map 3. Designated conservation areas - State of California

Executive Summary

of the Northern Spotted Owl Recovery Plan

Introduction

A recovery plan is called for by the Endangered Species Act to guide the management actions needed to bring a threatened or endangered species to a condition in which it no longer needs special protection of the act. The northern spotted owl (also referred to in the recovery plan as the spotted owl and the owl) was placed on the list of threatened species in June 1990. Since February 1991, a Recovery Team appointed by Secretary of the Interior Manuel Lujan Jr. has been formulating a recovery plan for the spotted owl. This report presents a draft recovery plan for the northern spotted owl for review and comment by the public and government agencies.

The northern spotted owl draft recovery plan provides a comprehensive basis for management actions to be undertaken by forest landowners and wildlife agencies to alleviate conditions threatening the species. Primary actions will be taken by federal land management agencies in the Pacific Northwest — the U.S. Forest Service, the U.S. Bureau of Land Management, and the National Park Service. The U.S. Fish and Wildlife Service will oversee implementation of the plan through its authorities under the Endangered Species Act.

State forest management and wildlife agencies in Oregon, Washington, and California also will take actions that contribute to recovery under the plan. These state agencies have an important role in managing state forests and in regulating forest practices on private land within their jurisdiction. Contributions from habitat on Indian lands also were considered in formulating the draft plan.

The draft recovery plan was developed following review of the scientific data from previous plans for the spotted owl, particularly the conservation strategy designed by the Interagency Scientific Committee (ISC) (Thomas et al. 1990), and by analyzing the most recent data available on owl populations and their habitat. This biological information was the basis for designing measures to achieve recovery.

Secretary of the Interior Lujan also asked that the Recovery Team consider other species and economic effects to the extent allowed by law. The Recovery Team made a substantial effort to determine the status and location of other species that could benefit from actions similar to those needed for owl recovery. Measures that would contribute to recovery of the owl, while also helping other species, were favored in decisions leading to the draft recovery plan.

Previous studies show that protection of sufficient habitat for a viable spotted owl population has substantial economic and social costs because of the reduction in timber harvests. The Recovery Team recognized that, under the Endangered Species Act, it could not consider measures short of achieving recovery for the northern spotted owl, even though such measures might cause significantly less economic and social losses. Instead, the Recovery Team looked for ways to achieve recovery that would cause less reduction in timber harvest and fewer job losses in the timber industry.

Recovery Objective

The objective of the draft recovery plan is to remove the northern spotted owl from the list of threatened species.

The Draft Recovery Plan

The northern spotted owl draft recovery plan has seven key elements:

1. A recovery objective and a set of criteria for determining whether conditions exist that would allow the northern spotted owl to be removed from the list of threatened species.
2. A network of designated conservation areas on federal forestlands, with each area designed to protect owl habitat sufficient to support a number of breeding pairs of owls.
3. A set of guidelines that govern management activities on federal forestlands in designated conservation areas.
4. A set of guidelines that govern management activities on federal forestlands outside of designated conservation areas.
5. A set of suggestions for contributions from nonfederal forestlands to support spotted owl populations.
6. A monitoring and research program that will provide new information on spotted owls and their habitat, and develop and test management techniques for promoting and maintaining owl habitat while allowing appropriate forest management.
7. Implementation mechanisms that provide oversight and coordination, relying primarily on existing authorities and forest management planning procedures.

Each of these elements is described briefly, followed by a discussion of the scientific basis for the plan and of the economic and social considerations built into the plan.

Delisting Criteria

The primary threat to the northern spotted owl leading to its designation as a threatened species is the reduction and fragmentation of its habitat in forests in Washington, Oregon, and northern California. Northern spotted owls use old-growth forests and other forests with similar characteristics for nesting, breeding, and rearing young. As timber harvesting has proceeded in the Pacific Northwest, the amount of habitat suitable for spotted owls has declined and remaining habitat areas have become smaller and more isolated from each other, particularly during the last 50 years. As a result, the population of spotted owls declined, in some areas rather sharply.

The objective of the draft recovery plan is to reduce the threats to the spotted owl so that it can be removed from the list of threatened species anywhere in its range. The decision to remove the spotted owl from the list of threatened species can be made on an incremental basis for individual areas, called provinces, or for groups of provinces. The range of the spotted owl has been divided into 11 provinces.

Four criteria must be met before delisting is considered: (1) A scientifically credible plan for monitoring owl populations and owl habitat must have been in effect for at least 8 years; (2) the population must have been stable or increasing, as indicated by both density and demographic estimates, for at least 8 years; (3) regulatory mechanisms or land management commitments must have been implemented that provide for adequate protection of breeding, foraging, and dispersal habitat, and (4) analyses must indicate that the population is unlikely to need protection under the Endangered Species Act during the foreseeable future. The draft recovery plan emphasizes that all of these criteria must be satisfied before delisting is considered.

Designated Conservation Areas

As the primary means for achieving recovery, the draft plan recommends establishing 196 designated conservation areas (DCAs) to provide approximately 7.5 million acres of federal forestland as the primary habitat for the northern spotted owl population. These DCAs include approximately 48 percent of the total remaining spotted owl nesting, roosting, and foraging habitat on federal lands (Figure ES.1). The largest DCAs are designed to support a population of 20 or more pairs of owls in habitat conditions that allow successful breeding and rearing of young. They are located to allow owls to disperse from one DCA to another. Each DCA contains areas of currently existing owl habitat combined with areas of younger forests. These younger stands will be protected so they can mature into owl habitat. The DCAs contain approximately 1,180 known owl pairs on federal lands. This represents about 48 percent of the total pairs currently known on all federal lands (Figure ES.2). When the DCAs become fully developed owl habitat, they will support a population of approximately 2,320 pairs of owls.

DCAs are located to take advantage of other forestland containing owl habitat that will not be harvested or will be harvested in a manner that does not reduce habitat value. Such areas include parks, wilderness areas, and certain administratively reserved areas. DCAs also are located in a pattern to reduce the risk to the owl population from natural threats such as fire, disease, and insects.

Management Rules for Designated Conservation Areas

The draft recovery plan recommends that activities on federal lands within the DCAs be focused on improving habitat conditions for spotted owls.

The following specific management rules for federal lands in DCAs are recommended.

1. No timber harvest is allowed in habitat suitable for northern spotted owls.
2. Silvicultural practices, such as thinning, will be used to promote rapid development of owl habitat in those areas that currently do not provide habitat suitable for owls.
3. Salvage of trees in stands significantly affected by fire, wind, insects, or diseases may occur but will be limited to safeguard owl habitat.
4. Management activities designed to reduce the risk of large-scale fire or insect infestation are limited to those needed to assure the continued existence of owl habitat within the DCA.
5. The recovery plan recommends that federal lands inside DCAs, with the exception of wilderness areas and national parks, be designated as critical habitat.
6. It also recommends that a management plan be prepared for each DCA before management activities are implemented.

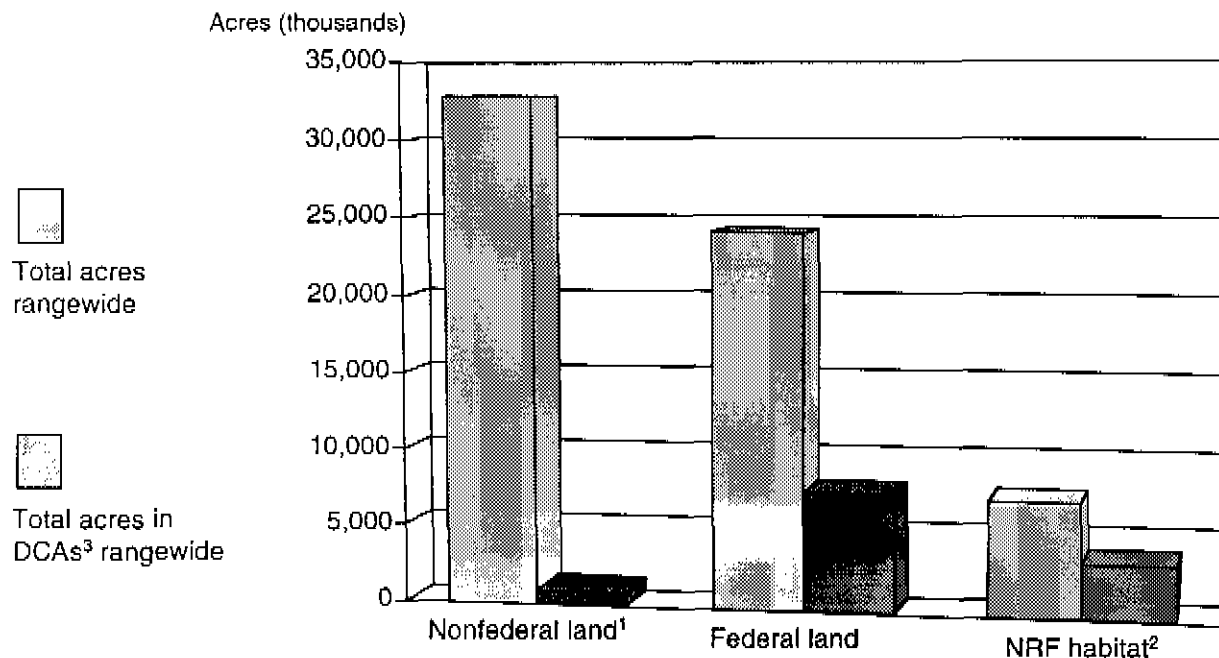


Figure ES.1. Total acres in the range of the northern spotted owl and in DCAs³ within the range.

¹No commitments are implied by inclusion of nonfederal land within DCA boundaries. Management of these lands is discussed in section III.C.4.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

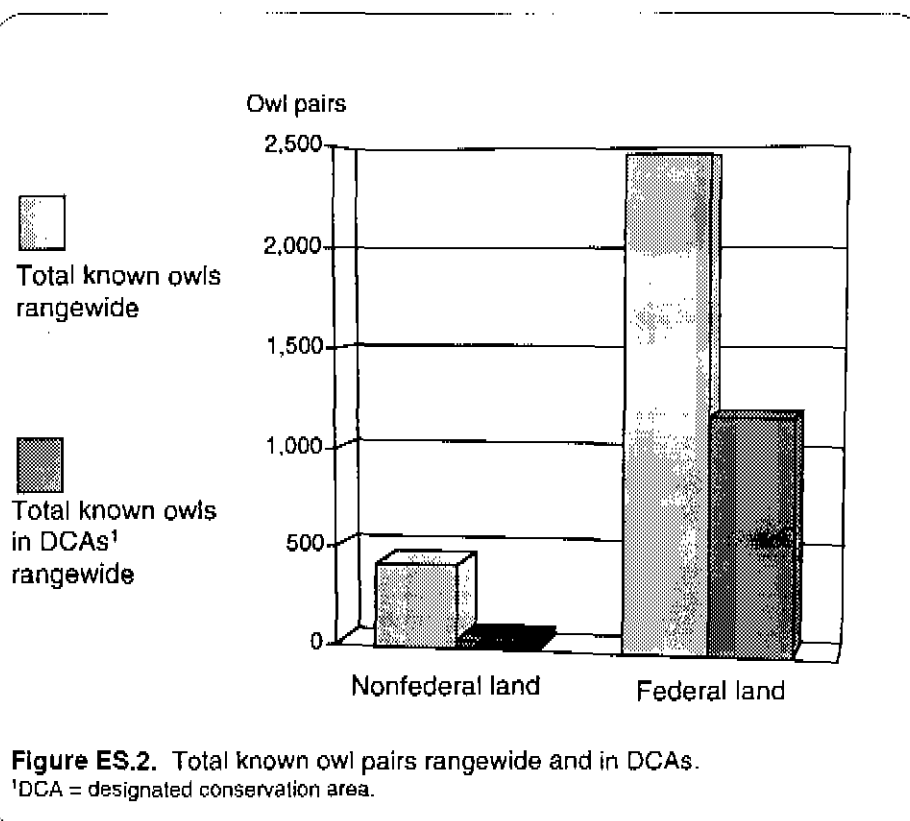
³DCA = designated conservation area.

Management Guidelines for Federal Forestlands Outside Designated Conservation Areas

The draft recovery plan recommends guidelines for the maintenance of sufficient habitat conditions on federal lands outside DCAs to allow dispersal of owls among DCAs. Movement among DCAs is necessary to maintain population levels and prevent genetic deterioration of the population. These guidelines also contain several recommendations for supplementing the DCA network in specific parts of the owl's range where conditions currently do not allow full implementation of the DCA network guidelines. This would be done by providing habitat for additional owl pairs and territorial single owls outside DCAs. In some areas, the draft recovery plan recommends management of these areas to reduce the risk of fire and insect damage. In total, these matrix areas in combination with the DCAs will provide for approximately 1,300 currently known pairs of owls on federal lands. This represents about 53 percent of all pairs currently known to occur on federal lands.

Suggestions for Management of Nonfederal Forestlands

The draft recovery plan relies first on federal lands for recovery of northern spotted owls. However, it also recognizes the role of nonfederal lands in recovery, particularly in areas where federal lands are not adequate to fully achieve the recovery objective. The recovery plan recommends specific contributions from nonfederal lands which will complement federal efforts. These recommendations reflect the varied conditions within individual provinces, the authorities of the three states involved, and the potential for enhanced cooperation with the private sector. They provide a framework for development and implementation of creative efforts to help achieve recovery.



Monitoring and Research Program

The draft recovery plan is based on extensive scientific data on northern spotted owls. This information gives the Recovery Team reasonable assurance that implementation of the draft plan will result in recovery of the species. However, increased knowledge of owls and their habitat will provide opportunities to refine and improve the plan. Consequently, the draft recovery plan recommends a comprehensive monitoring, research, and adaptive management program. The program has two objectives:

- 1) It will help produce information to assist in refining management guidance and practices to promote recovery and, to the extent feasible, achieve greater economic efficiency and effectiveness. The program will include assessments of how implementation techniques are applied and the results they achieve.
- 2) It will provide documentation necessary to consider delisting the owl in part or all of its range.

Information derived from the monitoring and research program eventually may result in significant changes in the Recovery Team's recommendations. The Recovery Team has a long-term goal to move from a landscape composed of protected areas and matrix toward a landscape where conditions provide a more continuous distribution of owls. Results from monitoring and research may support such a change. In any case, the delisting criteria still would be appropriate even if specific recommendations changed.

Implementation Mechanisms

Recovery plans are not self-implementing under the Endangered Species Act. Instead, they are used by federal agencies as a guide to refine management plans, procedures, and strategies so that on-the-ground operations help achieve recovery as it is defined in the draft recovery plan. Nonfederal parties are not required explicitly to follow recovery plans. However, they must follow applicable Endangered Species Act provisions that are reflected in the recovery plan. The draft recovery plan suggests an implementation schedule which, if followed, will expedite progress toward recovery and provide increased certainty and stability in owl management. Also, in recognition that actions are recommended which cover an extended time frame and involve federal and nonfederal parties, the draft recovery plan recommends establishment of a coordinating group to guide implementation efforts over the long term. The group would provide advice and assistance on policies, plans, and other aspects of management including monitoring and research.

The Scientific Basis for the Recovery Plan

The draft recovery plan is based on field studies of the habitat conditions that spotted owls prefer for nesting and breeding, on demographic studies, and on studies of owl behavior. It also is based on biological principles that describe the interactions within and among subpopulations that depend on areas of favorable habitat separated by areas of less favorable conditions. The Recovery Team drew substantially on theories and models of population dynamics to determine the desired size of population groups and the overall population.

The draft recovery plan also is based on silvicultural studies of the growth of forests under natural conditions and human management. Silvicultural models were used to study the opportunities for promoting more rapid development of suitable habitat conditions by appropriate management in younger stands.

Consideration of Economic and Social Effects

The draft recovery plan was designed to reduce economic and social costs without undermining recovery of the spotted owl. For example, it allows forest management within DCAs in areas that are unsuitable for owls if that management is designed to promote the development of suitable owl habitat. Some of that management may provide commercial wood products. It also uses much habitat already set aside as not suitable for timber harvest. The plan also provides programs and procedures to reduce the costs of its implementation. However, the cost of the plan still will be significant, and disruption will be experienced by individuals and communities when restrictions on timber harvesting cause unemployment.

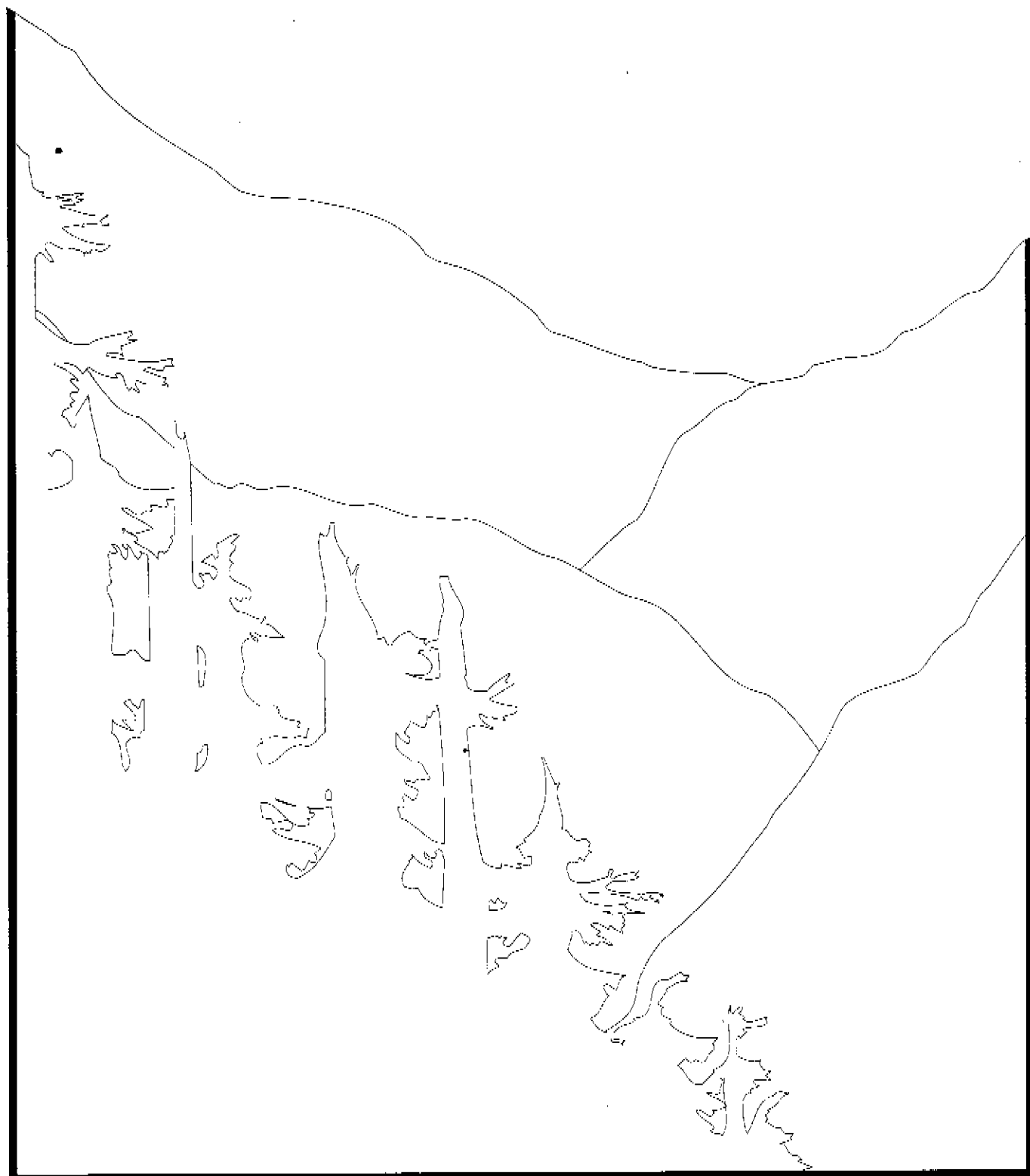
Implementation of the draft recovery plan is estimated to reduce employment in the Pacific Northwest timber industry by about 18,900 jobs, compared to the employment that would have been expected in 1995 with no protection of the spotted owl. Jobs in related sectors also will be reduced by about 13,200. Lost or reduced wages are estimated to be about \$1.4 billion during the coming 2 decades. The value of the foregone timber harvest is estimated to be \$470 million per year. This will cause a net reduction of about \$328 million per year in U.S. Treasury funds and \$100 million per year in county receipts. Private assets, such as mills and homes, also will be reduced in value.

Conclusion

The conservation of northern spotted owls is a difficult public policy issue. It is important to achieve recovery in a way that is appropriate under the Endangered Species Act, yet also managerially and economically efficient. The draft recovery plan provides a realistic basis for meeting this objective. Consequently, it should meet owl needs and provide greater stability in resource management than now exists. This will set a precedent for constructively resolving conflicts between conservation and development of natural resources.

Chapter I

Introduction



I.

A. The Northern Spotted Owl and the Endangered Species Act

1. How the Owl Came To Be Protected Under the Act

The U.S. Fish and Wildlife Service (FWS) first considered the possibility of listing the northern spotted owl (also referred to in the recovery plan as the spotted owl and the owl) under the Endangered Species Act in the early 1980s, but concluded that it would have been inappropriate. In 1987, a small organization known as GreenWorld, later joined by other environmental groups, petitioned the FWS to list the owl as endangered. The act's petition provisions required a preliminary finding within 90 days as to whether listing might be warranted. The FWS made a positive finding and initiated a review of the owl's status.

A second finding was required within 12 months of receipt of the petition. The second finding, directed at the question of whether listing was warranted, was more definitive than the 90-day finding. On December 17, 1987, the FWS found listing was not warranted.

The legality of the negative finding was challenged in court by several environmental groups, and the federal District Court in Seattle ruled that the finding appeared not to be supported by the status review that the FWS had conducted (see General Accounting Office 1989 for a review). When a judge ordered the FWS to produce a record that supported its decision, the FWS requested and was granted time to reconsider its finding in light of the most recently available information. In April 1989, the FWS made a finding that listing was warranted. A proposal to list the owl as a threatened species was published in June 1989, and the owl was listed effective July 23, 1990.

2. The Endangered Species Listing Process

A process for ascertaining which species need attention is basic to any program of species conservation. Section 4 of the Endangered Species Act assigns this task to the Secretaries of the Interior and of Commerce, and operational authority within the two departments is delegated to the FWS and the National Marine Fisheries Service. The responsibilities and authorities for listing under the act are framed very broadly as the determination "... whether any species is an endangered species or a threatened species . . ." Determinations are made by regulation through a proposal-and-comment process. In addition to this broad charge to the federal agencies to assess the status of species, the act provides a process for the public to petition for a species to be listed, and it makes the agencies accountable to petitioners. Some definitions are useful in understanding this assessment phase.

"Species" means any species or subspecies of plant or animal and, in the case of vertebrate life forms, may include any distinct population segment.

"Endangered species" means a species in danger of extinction throughout all or a significant portion of its range.

"Threatened species" means a species likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

The Endangered Species Act requires that listing decisions be made "solely on the basis of the best scientific and commercial data . . ." In this context, "commercial data" refers solely to information regarding trade in a species or products derived from it, and does not allow the probable economic consequences to affect a decision regarding a species' listing.

3. Critical Habitat Designation

The Endangered Species Act also directs the agencies to propose critical habitat "to the maximum extent prudent and determinable." Once again, the act's definitions are important.

"Critical habitats" are specific areas within the geographical area occupied by a species at the time of listing on which are found those physical or biological features (1) essential to the conservation of the species; (2) which may require special management considerations or protection; and (3) specific areas outside the area occupied by the species upon a determination that such areas are essential to its conservation.

"Conservation" means the use of all methods and procedures necessary to bring a species to the point at which the protective measures of the act are no longer necessary. Conservation is the process or means of achieving recovery. It is reasonable for the designation of critical habitat areas "essential to the conservation of the species" to consider the habitat needs identified in a recovery plan.

Designation of critical habitat is considered to be prudent when it would be of conservation benefit to the species for which it is designated. Critical habitat is determinable if sufficient information is available to adequately delineate the area or areas that should be included in the designation.

The act also requires an examination of the economic and other relevant impacts of the designation of critical habitat, and allows areas to be excluded from critical habitat if the benefits of exclusion outweigh the benefits of inclusion, unless exclusion would lead to the extinction of the species.

In the proposed and final listing of the northern spotted owl, the FWS deferred designation of critical habitat as "not determinable." Critical habitat must be designated to the maximum extent prudent and determinable at the time a species is listed. If critical habitat is not determinable at listing, the act allows an additional year beyond the one in which listing must progress from proposed to final. At the end of the second year, critical habitat must be designated to the maximum extent prudent. In further consideration of the case that challenged the FWS's original petition finding, the court did not accept the FWS's argument that critical habitat for the owl was not determinable, and ordered the FWS to publish a proposal to designate critical habitat by April 29, 1991. A proposal for 11.6 million acres of critical habitat was published on May 6, 1991. A revised proposal that reduced the area to about 8.2 million acres, principally by excluding private, Indian, and state lands, was published on August 3, 1991, and a final designation of 6.9 million acres was issued on January 15, 1992.

4. Recovery Plans

The Endangered Species Act calls for the preparation of recovery plans for listed species that are likely to benefit from the effort, and authorizes the Secretary of the Interior to appoint recovery teams. A recovery plan must establish recovery goals and objectives, describe site-specific management actions recommended to achieve those goals, and estimate the time and cost required for recovery. A recovery plan is not self-implementing, but presents a set of recommendations endorsed by an approving official representing the Department of the Interior:

The Secretary appointed an interdisciplinary Northern Spotted Owl Recovery Team in February 1991. The Secretary's directive to the team (see Appendix K) called for a biologically credible plan. The Secretary further directed that the plan should, consistent with its legal mandate, "address concerns such as: potential community and regionwide economic and social impacts; fiscal implications at the local, state and federal levels; compatibility with other legal mandates; effects on other threatened and endangered species and those species which might be listed in the future; and broader, ecosystem-related considerations."

The Northern Spotted Owl Recovery Team includes members of federal agencies, academic scientists, and representatives from the governors' offices in California, Oregon, and Washington. The Recovery Team held meetings each month from March to September 1991 that were open to the public and then met in closed session while it developed final options and recommendations for the Secretary's review.

At its first meeting, the Recovery Team established standing committees to address particular aspects of preparing the recovery plan; members of the committees are shown in Appendix K. Committees were established for owl biology, planning and implementation, forest ecology and management, other species, and economics. An executive committee also was formed whose membership included the Recovery Team chairman, team coordinator, and all committee chairpersons. The committees gathered information and provided evaluations in their respective subject areas for presentation to and action by the full Recovery Team.

The Recovery Team held numerous meetings as a full team and in smaller committees working on specific matters. Members visited a wide variety of owl habitats and forests in the three states, including lands in the Mt. Hood and Six Rivers National Forests, Olympic National Park, the Bureau of Land Management Eugene District, the Yakima Indian Reservation, Oregon's Tillamook State Forest, and several privately owned commercial forests.

The Recovery Team's mandate and its inclusion of some members with backgrounds in areas other than the biological sciences make it unusual among recovery teams. This structure enables the Recovery Team to consider and, as appropriate, to reduce the cost of recovery. It is also significant that Congress agreed to Conference Report language accompanying the 1992 Interior and Related Agencies appropriation bill encouraging the Recovery Team to consider the social and economic impacts of the recovery plan.

B. The Interagency Scientific Committee

While the proposal to list the northern spotted owl was pending, the four principal federal agencies involved in management of the owl (Forest Service, Bureau of Land Management, Fish and Wildlife Service, National Park Service) commissioned an Interagency Scientific Committee (ISC) to develop a conservation strategy for the owl. The committee delivered its product in April 1990 in the form of a strategy organized around the establishment of habitat conservation areas (HCAs) throughout the range of the owl, including an adaptive management approach (Thomas et al. 1990). The ISC strategy represented a significant gathering and synthesis of information on the biology and conservation of the owl and provided a point of departure for much of what subsequently has occurred regarding owl conservation. The ISC report concluded that at that time management strategies were inadequate to ensure the owl's viability. The ISC believed its strategy, "... if faithfully implemented, has a high probability of retaining a viable, well-distributed population of northern spotted owls over the next 100 years," (Thomas et al. 1990:4).

In many respects the task of the Recovery Team is similar to that of the ISC. There are, however, several significant differences. The most fundamental differences concern the frames of reference of the two groups. When the ISC was formed and prepared its strategy, the owl had not been listed as threatened and was not subject to protection under the Endangered Species Act. The strategy was commissioned by federal agencies, and members of the core committee of the ISC were federal employees. The committee had no obligation to and did not attempt to articulate its strategy in terms of the owl's recovery from threatened status.

The Recovery Team began its work after the owl had been listed. Protective measures had taken effect and were available as tools for conservation. The Recovery Team, appointed by the Secretary of the Interior, includes in its core membership academic scientists and representatives of the governors of the three affected states. Direct participation at this level by the states gave the Recovery Team a greater opportunity to address the entire range of the owl and management of owls on nonfederal lands than was afforded the ISC. Perhaps most important, a recovery team must, if possible, develop goals for the recovery of a species to the point at which it may be removed from the endangered or threatened list and also must describe criteria by which achievement of these goals can be recognized.

Similarities between the ISC strategy and this recovery plan arise from their common foundation in the biology of the owl and reliance on available management tools and principles of conservation biology. Differences between the two reflect the differing composition and charters of the groups that prepared them.

C. The Biological Basis of the Plan

The conservation measures in the recovery plan reflect general biological principles and specific knowledge concerning the biology of the northern spotted owl. In large part, the plan borrows from and builds upon the concepts and information presented in the ISC strategy. The following principles provide a biological basis for the plan:

- The risk of local or widespread extirpation will be reduced by managing for owls across their entire range and in the variety of ecological conditions within that range.

- Emphasis should be placed on management for clusters, or local population centers, of owls habitat blocks, rather than for individual pairs.
- Habitat conditions and spacing among local populations should provide free movement of owls to allow a metapopulation structure to operate.

For the owl, these principles result in recommendations for a) a network of designated conservation areas (DCAs) sufficiently large when possible to support 20 pairs of owls each, b) management within DCAs to maintain or increase suitable habitat for owls, and c) management to allow owls to move among DCAs. The size and arrangement of DCAs are based on information about the size of territories established by pairs of owls and the ability of owls to disperse. Knowledge of habitat characteristics needed to support owls provided a basis for recommending management of forestlands to support recovery. Throughout the plan, recommendations are tailored to locally specific information. Organization of recovery around multipair habitat areas is particularly appropriate for this species because of knowledge of its behavior, which includes significant inter-pair interaction.

In addition to owl conservation, the recovery plan considers the biology and conservation needs of other species that occur within the range of the owl. The recovery plan incorporates elements to benefit other species and general ecosystem values when doing so adds little or no additional cost while conserving the owl.

D. The Means of Achieving Recovery

The recovery plan recommends an approach to owl recovery that involves federal, state, and private sectors. The underlying strategy is interactive, and accordingly, recommends management objectives and practices consistent with the various implementation mechanisms available among these sectors. The Recovery Team believes *this approach is the most efficient and effective means* to achieve recovery. At the same time, however, the Recovery Team understands that the statutory mandates of the recovery planning process and the Endangered Species Act impose different requirements on land managers and owners. Accordingly, the recommendations place strong emphasis on the need for appropriate federal land management as a basis for recovery. As the plan is implemented, achieving or exceeding recommended state and private commitments in some physiographic provinces may hasten recovery, and perhaps ultimately enable greater flexibility in federal management than the plan now envisions. In other provinces, however, particularly where obstacles to recovery are acute, flexibility is not likely to be possible in the immediate future.

E. Sources of Information

Both published and unpublished documents (unpublished documents are commonly referred to as "grey literature") have been used as references in this plan. Grey literature has not been subjected to formal, rigorous peer review, and thus its acceptability among scientists as a source of information from which inference can be drawn is low. Likewise, published documents vary in their utility as sources of information. In general, popular articles (e.g., those in newspapers and magazines) have the lowest value as sources of unbiased information. With one exception, none is cited in this review. Privately pub-

lished works and many government documents are not usually formally reviewed, and often are referred to as grey literature. Peer-reviewed scientific journals, symposia, and books form the backbone of scientific literature. While peer review cannot, in most cases, assure the credibility of raw data, it does assure the reader that the information has been subjected to rigorous scrutiny of its methods, analysis, logic, and the appropriateness of an author's inferences and conclusions given the quality and amount of data and the analytical tools used to evaluate the data. In the case of the northern spotted owl, much of the available information is found only in grey literature. Grey literature frequently has been used in this document because it often represents the very latest field data. In addition, to categorically reject grey literature would result in a virtual absence of information derived from the timber industry. Use of such information should result in a more informative review and a stronger recovery plan.

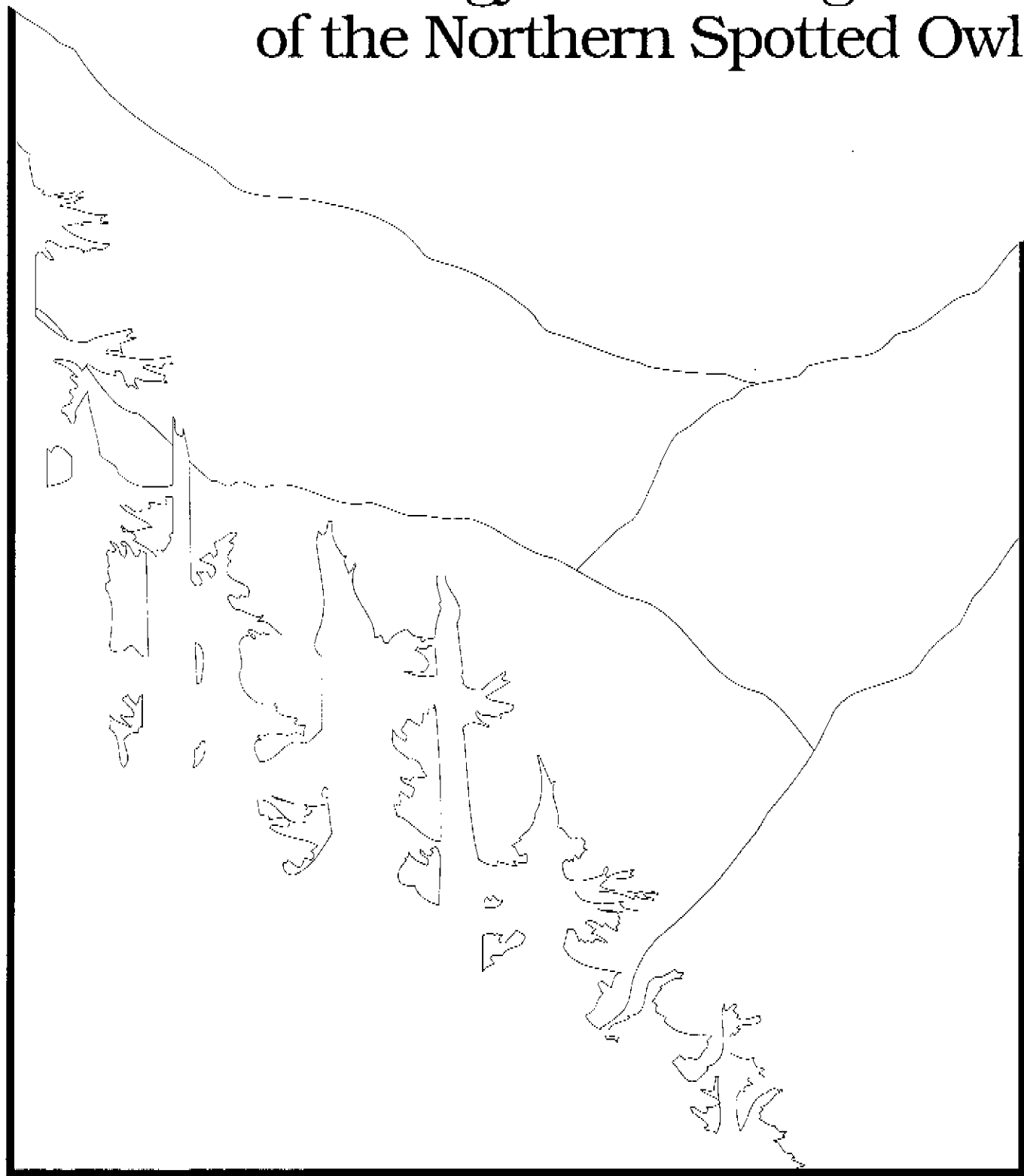
F. Acknowledgments

The Northern Spotted Owl Recovery Team has been assisted in its work by a legion of able cooperators. Many of these people volunteered their time and efforts in excess of what anyone could have plausibly expected, and have endured schedules and deadlines that can only be described as unreasonable. The list below is undoubtedly incomplete, and the Recovery Team regrets any omissions. To all named and any unnamed collaborators, we express our gratitude; we could not have completed our work without their contributions. James K. Agee, David Allen, David Anderson, Brad Andres, Keith Aubry, Phil Aust, Robert W. Baker, Allison Banks, Timothy A. Barnes, Joseph Beatty, Gary Benson, Marty Berbach, Bill Beyers, Monte Bickford, Bruce Bingham, Kevin Birch, Helen Birss, Andrew Blaustein, Kathryn Boula, Nancy Brooks, Charlie Brown, Ken Burnham, Bruce Bury, Andrew Carcy, Jill Carroll, John Charbonneau, Steve Corn, Eric Cummins, Tom Cyra, Larry Davis, William F. Delaney, Velma Delp, Nicholas Dennis, Randy Dettmers, Lowell Diller, Aimée Dour, James Eby, Ed Ehlers, Rich Everett, Robert A. Ewing, Lee Folliard, Eric Forsman, Louise Fortmann, Alan Franklin, Terrence Frest, Florissa Fuentes, Bob Gara, Keith Gilles, Brian Greber, Jeff Grenier, John H. Grobe, Tom Hamer, Michael Hamel, Melissa Hamel, Jeff Hannum, Mark Harmon, Connie Harrington, Michael Hay, Mauragrace Healey, Lorin Hicks, Patrick Higgins, Jerry Hoyer, Robert J. Hrubes, Mark Huff, Larry Irwin, Frank Isaacs, Kirk Jobeson, K. Norman Johnson, Rebecca Johnson, Connie Kahn, Boone Kaufmann, Jon Kennedy, Steve Kerns, Walt Knapp, William LaHaye, Jack Lattin, Robert G. Lee, George Leitner, Gary Lettman, Rob Lewis, Joe Lint, Bruce Lippke, Dan Luoma, Mike Lunn, Tom Lynch, Kathy Majors, Bruce Marcot, Sandy Martin, Bill McComb, Kevin McKelvey, William McKillop, Walter J. Mead, Chuck Meslow, Joe Meyer, Nanette Miller, Christine Moen, Andrew Moldenke, Jeff Morrell, Peter Morrison, Robert Motroni, Barry Mulder, Ed Murphy, Gil Murray, Jim Neely, Susan Nelson, Bill Nicstro, Barry Noon, Theron Odell, Kathy O'Halloran, Chad Oliver, Tom Owen, Dave Perry, Rick Peterson, Malcolm Pious, Ann Potter, Terry Raettig, Martin Raphael, Richard Reynolds, Jo Ellen Richards, Paul Roush, Frank Ryals, Bob Saunders, Mel Schamberger, Steve Self, Mike Skinner, David Solis, Paul Sommers, Tom Spies, Mike Srago, Argon Steel, John Steffenson, Dave Stere, Robert Storm, John Teply, Steve Tesch, Jack Ward Thomas, Dale Thornburgh, David Thorud, Melvic Uhland, Jerry Verner, Frank Wagner, Paul Warner, Bill Watterson, Phil Weatherspoon, Thomas Williams, Wendell Wilson, George Wyatt, Cindy Zabel, and John Zasada.

No project like this one comes to fruition without exacting a toll on the participants' personal support groups of family and friends. We appreciate the indulgence of those closest to us, who have put up with our frequent physical and mental absences during the preparation of this recovery plan.

Chapter II

Biology and Management of the Northern Spotted Owl



II.

A. Natural History of the Northern Spotted Owl*

1. Introduction

The northern spotted owl (*Strix occidentalis caurina*) is one of the most studied and best known owls in the world. The research effort on this subspecies rivals that on some European owls (Southern 1970, Saurola 1989, Nero et al. 1987). This degree of scientific attention is the result of this owl's association with late seral stage conifer forest of high commercial value in the Pacific Northwest (Forsman et al. 1984). The bird is the topic of vigorous debate among foresters, wildlife ecologists, academics, politicians, social scientists, and economists (Heinrichs 1984, Dawson et al. 1987, Dixon and Juelson 1987, Simberloff 1987, USDA 1988, Gup 1990).

Because of this widespread interest, three major management plans have been developed to protect the viability of the northern spotted owl (USDA 1988, Thomas et al. 1990, USDA 1991). These documents have been reviewed by scientists (Murphy and Noon In Press) and special interest groups alike (Boyce 1987, Green 1991, Reich 1991, Sheriff 1991). Two reviews of the owl's ecological status have been conducted by the FWS (Gore et al. 1987; USDI 1990). These plans have received widespread scrutiny in the scientific literature, and the press, by government agencies, and the courts (Simberloff 1987, Gup 1990, GAO 1989, Portland Audubon Society v. Lujan 1991, respectively). In addition, several literature reviews and critiques have been written during the past decade that document the history of knowledge acquisition on this unique nocturnal predator (Solis 1980, Forsman 1984, Gutiérrez 1985, Gutiérrez and Carey 1985, Dawson et al. 1987, Gore et al. 1987, Forsman 1988a, Thomas et al. 1990, USDI 1990). The objective of this section is to summarize the ecology of this controversial animal.

The seminal work on the natural history of the northern spotted owl is Forsman et al. (1984). However, Thomas et al. (1990) will serve as a reference point for specific data on certain aspects (home range size, habitat, and food habits) of the natural history of the northern spotted owl in this literature review since that work represents the most complete data yet assembled about the northern spotted owl.

2. Natural History

Description

The northern spotted owl (*Strix occidentalis caurina*) is a medium-sized owl found in the Pacific Northwest. It is chocolate brown with round to elliptical white spots on the body feathers and white bars on the tail. Other common

* Prepared by R. J. Gutiérrez

distinguishing features are its dark eyes surrounded by tawny facial disks. Males and females are not easily distinguishable by plumage characters, although Barrows et al. (1982) suggested that the sex of spotted owls can be determined from the number of tail bars. Moen et al. (1991) reported that the tail-bar technique is unreliable for sex determination. However, a spotted owl's sex is recognized readily by voice (Forsman et al. 1984; see voice description under Behavior) and size (Forsman et al. 1984, Blakesley et al. 1990). Spotted owls, and owls in general, show reversed sexual dimorphism: females are larger than males (Blakesley et al. 1990:323). This reversed sexual dimorphism exists in all commonly measured physical features, but body mass is the single best physical predictor of sex in this owl (Blakesley et al. 1990:323).

Plumage characteristics can be used to distinguish among several age classes of spotted owls. Juvenile spotted owls (ages 1 day to approximately 5 months) are distinguished by visible down feathers (Forsman 1981). The proportion of down feathers decreases with age. Subadult birds are distinguished by the presence of adult plumage and white-tipped, pointed tail feathers (Forsman 1981). In northern spotted owls, two subadult age classes can be recognized. Subadults that are 1 year old have a downy tuft at the tip of the pointed tail feathers, whereas this downy tuft is lost by a bird's second year (Moen et al. 1991). Adult (i.e., more than 27 to 28 months old) birds have rounded tips on the tail feathers, which usually are mottled in color.

Range And Distribution

The range of a species is that general geographic area within which the species may occur. A species' distribution may be synonymous with its range or it may be specific to the habitat types in which it occurs within its range. Northern spotted owls are found from southern British Columbia, Canada, south to Marin County, California. They range eastward through this area to the edge of the Palouse prairie in Washington and the Great Basin shrub steppe in Oregon and California. Although northern spotted owls are sighted in almost all areas of their general range (e.g., urban areas, beach dunes), their breeding distribution is restricted to forest communities (see Habitat). They are found from sea level to as high as approximately 7,500 feet in the southern portion of their range and to approximately 4,000 feet in elevation in the northern part of their range. Densities of owls vary across this broad range according to habitat type, habitat quality, and habitat quantity (Thomas et al. 1990). The current distribution of known spotted owls within their historic range is in Figure 2.1.

Taxonomy And Genetic Relationships

Spotted owls are members of the largest family, Strigidae, within the order Strigiformes. Some controversy exists regarding the taxonomic and systematic relationships of birds within this order (Sibley et al. 1988, Cracraft 1981), although most of the discussion centers on higher taxonomic levels. The genus *Strix* is a widely distributed group of owls with members occurring in the Nearctic, Palearctic, Neotropical, and Indian fauna regions (Clark et al. 1978). In North America there are three species of *Strix*: the spotted owl, the barred owl (*Strix varia*), and the great gray owl (*Strix nebulosa*; Johnsgard 1988). *Strix* owls may be most closely related genetically to owls in the genus *Athene* (Randi et al. 1991).

Spotted owls were described by early naturalists as three subspecies (the northern spotted owl; the California spotted owl, *Strix occidentalis occidentalis*; and the Mexican spotted owl, *S. occidentalis lucida*). The California spotted owl was first described by Xantus (1859) from a specimen collected in the

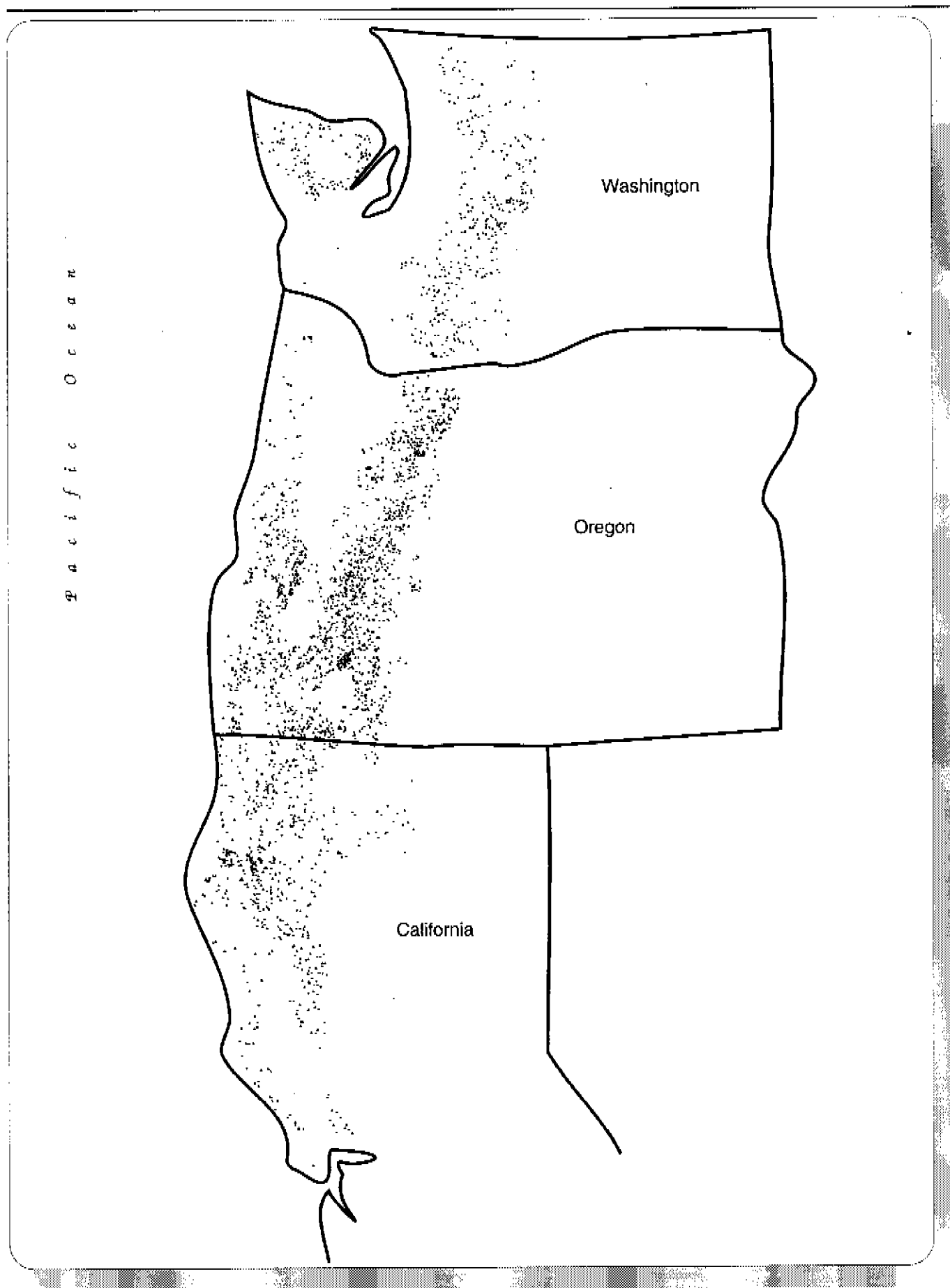


Figure 2.1 Distribution of known spotted owl pairs located in Washington, Oregon, and California between 1986 and 1990.

Tehachapi Mountains of southern California. The northern and Mexican subspecies were named by Merriam (1898) and Nelson (1903), respectively, on the basis of plumage color and other morphological characters. Early naturalists often named subspecies on the basis of slight differences in plumage or size variation. Thus, it was not surprising that Oberholser (1915) recommended that the California spotted owl and the northern spotted owl be merged as one subspecies because of the large variation and overlap in plumage characters between the two subspecies. This recommendation apparently was not accepted by the American Ornithologists' Union (1957) Committee on Nomenclature. More recently the American Ornithologists' Union Committee was requested to reevaluate the subspecific status of the northern and California subspecies. However, it declined to change the current designation because of a lack of adequate study of the subspecies characters (see discussion in Thomas et al. 1990:59). Nevertheless, the original boundaries delineating the subspecies' ranges were clearly arbitrary (Gould In Prep.).

Barrowclough and Gutiérrez (1990) attempted to elucidate the relationships among the three subspecies using allozyme electrophoresis (a technique employed to assess genetic variation). They compared patterns of protein variation at 19 presumptive loci among eight populations of the three subspecies. Surprisingly, they found no detectable variation among the Pacific Coast populations for any of the loci. One major allelic difference was found between the coastal and Mexican subspecies. Thus, their results did not resolve the subspecific relationships of *caurina* and *occidentalis*. However, *lucida* was clearly a distinguishable taxon, and it probably has been separated from the coastal forms for many hundreds of years (Barrowclough and Gutiérrez 1990:742).

Low levels of genetic variation in wild populations are considered to be a threat to their evolutionary potential (Frankel and Soule 1981). This is because a population with low genetic variation would not have the variety of genes upon which natural selection could act to promote adaptation to changing environmental conditions over evolutionary time. However, the lack of electrophoretic variation in the coastal forms of spotted owl does not demonstrate unequivocally that these subspecies are genetically depauperate. Barrowclough and Gutiérrez (1990) discuss possible alternative explanations for the lack of electrophoretic variation found in spotted owls.

It is evident from the few studies conducted on the taxonomic and genetic relationships of spotted owls that more needs to be learned to estimate both current levels of genetic variation in populations and hybridization with the barred owl. A few California/Mexican hybrids are known from the wild (see intra- and interspecific relationships). Hybridization is common among closely related wild birds that are classified as separate species. The key issues to be resolved in evaluating hybridization as a threat to spotted owls is the extent of hybridization (i.e., the levels of gene introgression), and the viability of hybrids. Barrowclough and Gutiérrez (pers. comm.) currently are using advanced molecular genetic techniques to help answer some of these questions.

Behavior

Adaptations of a Nocturnal Predator: Spotted owls are primarily a nocturnal predator (Bent 1938). Like other nocturnal owls, spotted owls possess three primary adaptations for night life: exceptional eyesight, exceptional hearing, and modified feathers to facilitate silent flight (Payne 1971, Konishi 1973, Clark et al. 1978, Martin 1986). Spotted owls are perch-and-pounce predators (Forsman 1976). That is, owls select a perch and wait, trying to locate potential prey either by sight or sound; once prey is detected, they try to capture it with their talons. If prey is located in an inaccessible location or at

some distance, the owls may move closer to the animal. The spotted owls' silent flight allows them to fly close to potential prey without detection by the prey. Spotted owls are agile creatures and can capture arboreal (i.e., living in trees) or terrestrial (i.e., living on the ground) prey. In addition, these owls will exhibit "hawking" behavior (i.e., capturing flying prey, primarily birds and insects).

Although spotted owls are nocturnal, they can be active during the day. Spotted owls forage opportunistically during the day (Laymon 1991, Sovern et al. In Prep.). They also move short distances during the day to change roosting position in response to changes either in ambient temperature or exposure to direct sunlight (Barrows 1981, Solis 1983, Forsman et al. 1984).

Several hypotheses have been proposed as possible explanations for this species' affinity for late seral stage and old-growth forests. These hypotheses have been described as the nesting, thermoregulation, predation, prey, or general adaptation hypotheses (Barrows 1981, Forsman et al. 1984, Carey 1985, and Gutiérrez 1985). Each hypothesis is discussed in an appropriate section.

Vocalizations: Spotted owls communicate using a variety of hoots, "barks," and whistles (Forsman 1976, Forsman et al. 1984). The precise context of some of these calls is unknown, but researchers generally agree on the function of some of the more common calls. The most common call given by spotted owls is the four-note location call (FLC) (Forsman 1976, Forsman et al. 1984, Fitton 1991). The next most common call is the multiple-note series location call (SLC) (Forsman et al. 1984, Fitton 1991). The FLC can be described phonetically as "hooo hoo hoo hooo." FLCs often are given in replicates of two. SLCs are highly variable renditions of the basic FLC (Forsman et al. 1984, Fitton 1991). The FLC is used by males and females to announce territory occupancy and in territorial disputes. However, this same call, with lower pitch and intensity, also is used by the male to announce prey delivery to the female as well as in other behavioral interactions. SLCs are used by birds when they are agitated. Whistles usually serve to establish contact between a pair (Forsman et al. 1984). Calls of spotted owls also vary spatially and temporally (Gancy 1990, Fitton 1991).

Spotted owl calls are relatively low-pitched and composed of pure tones (Fitton and Gutiérrez In Review). This is believed to be an adaptation to communicate in dense (forest) vegetation (Morton 1975). One can infer from call structure that spotted owls have evolved in forest environments.

The spotted owl is unusual among the Strigidae because it apparently has the ability to learn a neighboring spotted owl's call and then make fine adjustments to its own call to imitate the neighbor's call (Fitton and Gutiérrez In Review). Primitive birds such as owls usually do not have the ability to learn calls (Kroodsma 1982). One adaptive advantage of call learning for a species with a large home range may be to prevent aggressive territorial interactions with known neighbors, which probably are energetically costly to this animal. That is, if a bird cannot recognize its neighbor's call, it must expend time and energy defending its territory every time it hears an owl calling near its territory. Call learning also suggests that spotted owls have evolved in the presence of neighbors. Thus, management plans that feature isolated habitat patches do not appear consistent with the biology of this bird.

Intersexual Relationships: The central unit of a spotted owl's life cycle is a functional territory. A functional territory is occupied by a pair of reproductively active birds. It is a defended area in which survival and reproduction are sufficient to ensure replacement of the pair in the future. In contrast, a nonfunctional territory would be a defended area in which the habitat conditions did not allow either successful reproduction or reliable survival of off-

spring. Territories probably are smaller than home ranges, but the exact relationship between the defended area and the used area is unknown. Both members of a pair vigorously defend the territory through vocalizations and visual displays. This propensity to defend a territory also is the key to successful study of the species because one can locate the birds through imitation of their calls.

Spotted owls often form long-term pair bonds (Forsman et al. 1984). Pair bonds do occasionally dissolve, but the reasons for "divorce" are unknown (Franklin and Gutiérrez unpubl. data). Nevertheless, several behaviors occur commonly among spotted owls that serve to illustrate mechanisms that probably have evolved to reinforce pair bonds. Calling serves to strengthen pair bonds when it is given in the appropriate context (e.g., nest site selection, prey delivery). Courtship feeding by the male is common during the early part of the nesting cycle (Forsman 1976) and may serve as a proximate cue to either food availability or the male's ability to hunt successfully. Finally, physical contact, as exemplified by "allopreening" (i.e., mutual preening of feathers), also serves to strengthen pair bonds (Forsman and Wight 1979). Allopreening is common in other *Strix* owls (Fitzpatrick 1975, Nero 1980), and is ingrained so strongly in these birds that captured owls may engage in allopreening with their captors (Nero 1980).

The nesting cycle begins with the return of the pair from the wintering area to the nesting area in late winter or early spring (late February to early March). The pair begins to roost together on a more frequent schedule as day length increases. The initiation of laying is contingent upon the physical condition of the female, the availability and abundance of prey, and the ability of the male to capture sufficient prey. The condition of the female probably depends on the female's hunting experience and the prey levels within the territory during the winter and the preceding fall. Once a pair is committed to nesting, the female lays her clutch of eggs and incubates and broods the young without assistance from the male. In fact, during incubation and the first half of the brooding period, the female leaves the nest only to defecate, regurgitate pellets, avoid predation, defend against conspecifics (i.e., other spotted owls), or receive prey delivered by the male. The role of the male is to provide sufficient food to the female so that the female need not forage. Once the young have hatched, the juveniles remain 3 to 5 weeks before leaving the nest. Owlets often leave the nest before they can fly, simply jumping from the nest into the surrounding tree branches or onto the ground. These young birds are fed and tended by one or both of the adults until they disperse in early fall (late September or early October, see Dispersal). Following dispersal of the young birds, adult birds begin to expand their home ranges and to roost together less frequently, signaling an end to the annual reproductive cycle.

Intra- And Interspecific Relationships

Competition: Intraspecific competition is the competition for resources among members of the same species. Territoriality is one expression of intraspecific competition. One adaptive advantage of territoriality is that it allows a territory holder to sequester resources for exclusive use. Because spotted owl prey are patchy in distribution and variable in abundance (Ward 1990), it is important, if not necessary, for spotted owls to defend territories and use large areas for foraging.

Preliminary information on habitat selection gathered by Solis and Gutiérrez (1990) and Sisco (1990) suggest that intersexual (competition between males and females of the same species) competition may have led to foraging habitat segregation between males and females. It appears that males and females select forests of different structure, and that the smaller males hunt in denser

forests. Alternatively, habitat selection by each sex may be the result of reversed sexual dimorphism, which may have evolved for other reasons besides food competition (Muller 1986).

Competition for resources can occur between different species, this is commonly called interspecific competition. The use of any finite resource in one area by more than one species can result in competition, if the depletion of the resource by one species negatively affects another species. Competition is commonly invoked as a selective mechanism for the evolution of niche partitioning (Cody 1974). For example, the relative differences in body size of members of the Pacific Northwest owl community may be an expression of past competition that led to the evolution of differences in body size and foraging strategies that minimize diet or habitat overlap. Alternatively, the owl community structure simply may be an expression of adaptive radiation (adapting to regional environmental conditions) at some time in the past (Wiens 1989). Nevertheless, competition can be a serious problem for a species when an exolic (nonnative) animal of similar body size and ecological requirements invades its habitat. The recent invasion of the barred owl into the range of the spotted owl (Taylor and Forsman 1976) is an example of potential competition between closely related species. Barred owls are larger and more aggressive than spotted owls in interspecific territorial interactions. They also feed on a broader range of prey, occupy a wider range of habitats, and have smaller annual home ranges than do spotted owls (Flamer 1988). Further, they are known to have displaced spotted owls from their territories (Allen pers. comm.). Thus, barred owls are a competitive threat to spotted owls.

Hybridization: At least three spotted owl/barred owl hybrids have been observed in the wild (Forsman pers. comm.). It is common in nature for closely related species to hybridize, especially where habitat disruption has occurred (Short 1965, Johnsgard 1970, Mayr and Short 1970, Short 1972). Vincent (1990) expressed concern about the recent invasion of barred owls and the potential effect of hybridization on the integrity of the spotted owl as a species. Several biological outcomes are possible given the rapid expansion of barred owls into the range of the spotted owl. First, the barred owl could, through extensive hybridization, genetically "swamp" the spotted owl. Second, a "hybrid swarm" could develop in specific areas of contact. Third, selection could act against hybrids, thus favoring development of effective isolating mechanisms. Fourth, low levels of hybridization could occur continuously without loss of the identity of either species. Fifth, hybridization could be a random event. In only the first case is the genetic integrity of the spotted owl seriously challenged. However, in declining populations any loss of spotted owl reproductive capacity to hybridization must be considered a real threat, but primarily because of its effect on the short-term demography of the species.

Predation: Another form of interspecific interaction is predation (the killing of one organism by another for food). As a medium-sized owl, the spotted owl kills and eats smaller owls. Therefore, it is not surprising that the larger great horned owl (*Bubo virginianus*) kills and eats spotted owls. This is called a food chain. Predation by great horned owls on spotted owls is a potential hypothesis to explain spotted owl use of old-growth forests, or to explain spotted owl avoidance of open habitats (Forsman et al. 1984). These two species commonly share the same habitats, but great horned owls tend to occupy sites that are more fragmented and open than those used by spotted owls (Johnson pers. comm.), perhaps because their large size makes them less maneuverable in dense forest. There is no current test of this hypothesis (i.e., relative predation rates by great horned owls on spotted owls using habitats with different structure). However, great horned owls probably prey on spotted owls opportunistically rather than seeking spotted owls as prey (Forsman pers. comm.).

Northern goshawks (*Accipiter gentilis*) also prey on adult and juvenile spotted owls (Forsman et al. 1984, Gutiérrez et al. 1985, Miller 1989, Johnson 1991 pers. comm.). Nevertheless, spotted owls will nest within a goshawk territory (Forsman et al. 1984) and will defend their young against attacks by goshawks (Gutiérrez unpub. data). Thus, goshawks probably are not serious threats to spotted owl populations.

Until recently, people rarely have encountered spotted owls and there has been no historic persecution by humans of this docile creature. The recent, conspicuous rise in spotted owl deaths at the hands of humans is a potential threat to local owl populations.

Diseases and Parasites

Disease and parasite infections represent another form of interspecific interaction because it is the relationship (in the broad biological meaning) of one organism with another. However, the topic of pathogens is treated separately here because it is treated separately in status analyses by the FWS when listing a species as threatened or endangered.

Relatively little is known about the diseases and parasites of spotted owls. Gutiérrez (1989) conducted an extensive survey of hematozoan parasites (those that live in the blood) among all three subspecies of the spotted owl. Of the six hematozoan species found, all but one species occurred in the northern spotted owl. The infection rate was 100 percent, which was one of the highest rates of infection by these parasites recorded among birds (Greiner et al. 1975). However, spotted owls must be adapted to carry these high parasite loads because their survival rates are very high where infection rates are high (e.g., northwestern California, see following text). Hoberg et al. (1989) examined 20 northern spotted owls for helminth (worm) parasites and found eight species, representing nematodes (round worms), cestodes (flat worms), and acanthocephalans (spiny-headed worms). More than 80 percent of the birds were infected with at least one species; and multiple infections were common. Young et al. (In Review) reported two hippoboscids fly (louse) species from spotted owls in northwestern California. One species of fly was recorded only once among the 382 owls examined, but approximately 17 percent of the owls they examined were infested by the other species. Fly densities on owls were higher in years of higher summer and fall temperatures and lower winter precipitation. The authors speculated that low temperatures may have depressed survival of fly pupae. Finally, Forsman (pers. comm.) observed two nests where owlets had such high infestations of hippoboscids that the flies caused severe trauma to the young birds.

Habitat

Habitat selection and its context: Perhaps the most controversial aspect of the natural history of the spotted owl concerns its habitat requirements. Thomas et al. (1990:143-144) discussed the complex habitat needs of the northern spotted owl.

Most species exhibit variation in habitat selection (i.e., most species are not strict habitat specialists). Spotted owls are known to use many habitats. Empirical observations of spotted owls in different habitats can provide understanding of the birds' habitat requirements at three different levels (Peck 1986). *Habitat use* is the simple observation of an animal in a habitat without understanding the context of the observation. *Habitat selection* is the choice of a habitat or habitats among those that are directly available to the animal. *Habitat preference* is the selection of habitat that would be made by an animal

If all habitats were available to the animal. Thus, we have many observations of spotted owl habitat use, fewer studies of habitat selection, and no studies of habitat preference as defined by Peck (1986). Early studies portray the northern spotted owl as a denizen of primal forests (Grinnell and Miller 1944) based on observations of habitat use. However, Grinnell and Miller (1944) found that geographic variation in habitat use did exist in spotted owls. Subsequent investigations (Forsman 1976, 1980, Solis 1983, Forsman et al. 1984, Gutiérrez et al. 1984, Solis and Gutiérrez 1990, Sisco 1990, Blakesley et al. In Press, Bart and Forsman 1992) reaffirmed the naturalists' notions from observations of habitat use, but more importantly, provided analyses of habitat selection. Recent surveys of managed (i.e., previously logged private lands) forests have added to the knowledge of habitat use (Diller 1989, Irwin et al. 1989a, 1989b, Kerns 1989, Pious 1989). These latter observations are important, but their ecological significance is enigmatic because, unlike studies conducted on public land, there is no supporting demographic information. It is essential that more demographic information be gathered to evaluate these populations (see section on spotted owl use of young, managed timberlands).

Variation in habitats used: Spotted owls are known to nest, roost, and feed in a wide variety of habitat types and forest stand conditions throughout their distribution (see discussion of suitable habitat elsewhere in this document). Spotted owls use western hemlock, mixed evergreen, mixed conifer, Douglas-fir, redwood, Douglas-fir/hardwood, evergreen hardwood, ponderosa pine, western red cedar, and other forest types in different parts of their range. Most observations of spotted owl habitat use have been made in areas having a component of old-growth and mature forests (Solis 1983, Forsman et al. 1984, LaHaye 1988, Sisco 1990, Ward 1990, Zabel et al. In Prep.; see additional summaries in Thomas et al. 1990). However, observations of spotted owls in managed (i.e., previously logged) stands are commonplace (Diller 1989, Kerns 1989, Pious 1989). Studies evaluating habitat selection show owl selection for mature and/or old forest stands with concomitant selection against young stands (Forsman 1980, Solis 1980, Carey et al. 1990, Blakesley et al. In Press). Selection for forest stands of intermediate age and size vary among the owls studied.

Nesting habitat: Most northern spotted owl nest sites observed on public lands have been located in old-growth or mature forests (Forsman et al. 1984, LaHaye 1988). In addition, the proportion of older seral stage forest surrounding nests has been significantly greater than it was in surrounding random sites in the same area (Meyer et al. 1990, Ripple et al. 1991). In areas of private managed forest, particularly in the California Klamath and California Coast physiographic provinces, where some uneven-aged silviculture has occurred or where fast tree growth facilitates rapid habitat development, spotted owls are known to nest in managed stands, especially if residual old-growth characteristics are present (Forsman et al. 1977, Diller 1989, Pious 1989, Thomas et al. 1990; see Appendix B).

Spotted owls do not build their own nests; they depend upon suitable naturally occurring nest sites. In older-age forests, owls tend to nest in broken-top trees and cavities; they use platforms (i.e., abandoned raptor nests, squirrel nests, mistletoe brooms, debris accumulations) less frequently (Forsman et al. 1984, LaHaye 1988). In younger forests (i.e., forests less than 150 years old), nests more frequently are found on platforms (LaHaye 1988, Irwin et al. 1989a, Buchanan 1991). In one California study (LaHaye 1988), the proportion of platform nests used by spotted owls increased north to south, but the trend probably is related to the distribution of stand ages in that study rather than latitude.

The presence of suitable nest sites has been hypothesized as one possible basis for the use of old-growth by spotted owls (Forsman et al. 1984). However, owls

also use a variety of nest sites in younger-aged stands. But one critical piece of information should be assessed before this hypothesis can be tested. That is, the relative nesting success of birds using cavities and broken-top sites should be compared to that of birds using the presumably structurally less stable debris platforms. In any event, artificial nest sites probably could be provided for these birds (Madison and Woodbridge pers. comm.). European owls in the genus *Strix* readily use nest boxes (Southern 1970, Saurola 1989). If spotted owls behave in a similar fashion to other *Strix* owls, the availability of nest sites probably is not a critical management problem. However, a critical study of nest-box acceptance by spotted owls has not been conducted.

Several studies have been conducted on the structure of spotted owl nesting habitat (LaHaye 1988, Buchanan 1991, Self and Nelson 1991 pers. comm.). In the two studies that compared nest sites with available habitat, one in unmanaged forest and the other in managed forest (LaHaye 1988 and Buchanan 1991, respectively), owls nested in forests that differed from what was available to them, suggesting selection by the owls. In general, owls preferentially used forests with greater complexity and structure. Nesting habitat structure reported by Self and Nelson in managed forests (1991 pers. comm.) was strikingly similar to the habitat structure used by foraging spotted owls in unmanaged stands within the same province (Solis 1983).

Roosting habitat: Northern spotted owl roosting habitat has been described by Forsman (1976), Barrows and Barrows (1978), Forsman (1980), Solis (1983), Forsman et al. (1984), Chavez-Léon (1989), Sisco (1990), and Blakesley et al. (In Press). Roost sites are typically areas of relatively dense vegetation (high canopy closure dominated by large-diameter trees). During the summer these sites are usually cool, shady spots near streams or are on the lower third of slopes (possibly a simple correlation with stream position; Forsman 1976, Solis 1983, Blakesley et al. In Press). Spotted owls respond to variation in temperature and exposure by moving within the canopy to find favorable microclimate conditions (Forsman 1976, Barrows and Barrows 1978, Forsman 1980, Barrows 1981, Solis 1983, Forsman et al. 1984). The multistoried stand structure of roost sites facilitates this movement. Because of this observed behavioral response to variation in temperature, it has been hypothesized that old-growth forests are necessary to spotted owls for them to avoid heat stress (Barrows and Barrows 1978). However, Gutiérrez (1985) pointed out that there are other plausible hypotheses to explain the associated owls with old-growth.

Foraging habitat: Of the major spotted owl habitat categories, feeding habitat appears to be the most variable (summarized in Thomas et al. 1990). This is predictable given the highly variable distribution and abundance patterns of the owl's primary prey (Ward 1990). Within a given geographic province, foraging habitat may be more variable than either nesting or roosting habitat. Nevertheless, spotted owl foraging habitat is characterized by high canopy closure and complex structure. Comparisons of habitat among unmanaged stands used by foraging owls and managed stands occupied by nesting owls shows a surprising concordance of structural habitat features in California (Appendix B).

Solis and Gutiérrez (1990) presented evidence that male and female spotted owls may segregate their foraging habitat. The smaller males appeared to be using stands that had higher tree density than were the larger females, which foraged in less dense habitats. Earhart and Johnson (1970) suggested that differential habitat use by male and female owls may occur because the high wing loading of the females would make them less maneuverable than males. However, this probably would be a consequence rather than a cause of reversed sexual dimorphism (Muller 1986, Solis and Gutiérrez 1990).

Spotted owl use of young, managed timberlands: The significance of the owl's relationship to old-growth forests (*sensu* Old-growth Definition Task Group 1986) is obvious: old-growth forests are declining rapidly throughout the owl's range as a result of logging (Thomas et al. 1990, USDI 1990). If northern spotted owls are ecologically dependent (Ruggiero et al. 1988) on old-growth or mature forests, then continued logging of their habitat will lead to the probable extinction of the population (Thomas et al. 1990, USDI 1990). However, Forsman et al. (1977), Forsman (1988b), and Hays et al. (1989) reported spotted owls occupying young, managed stands at lower densities than in old-growth stands. A managed stand is defined in a broad context, that is, managed stands in which cutting of trees has occurred. This clarification is necessary because there are no examples of forests in which logging or silviculture has occurred where the response of owls is documented experimentally. Further, Forsman (1980), Solis (1983), Forsman et al. (1984), LaHaye (1988), Chavez-Lee (1989), Solis and Gutiérrez (1990), and Sisco (1990) describe habitat used by northern spotted owls in both old-growth and mature stands. Their descriptions of mature forest structure used by spotted owls is similar to the structure of uneven-aged managed forests in northwestern California (Appendix B). Thus, it is not surprising that spotted owls are being observed in younger managed timberlands throughout the distribution of the subspecies (Diller 1989, Irwin et al. 1989b, 1989c, Kerns 1989, Pious 1989). There is hierarchy of information needed to assess and understand these observations of owls in managed forests. In order of increasing importance, these classes of information are 1) presence of individuals, 2) presence of pairs, 3) density, 4) variation in reproduction, 5) survival schedules, 6) dispersal patterns, 6) ratio of internal to external recruitment, and 7) population stability. The structure and proportions of habitats used by owls relative to available habitats are also necessary to evaluate the observations. Finally, future harvest patterns must be known and must accommodate owl needs in order to predict the effects of the logging activities on the birds inhabiting these managed timberlands.

On one side, this habitat variation argues that spotted owls are not habitat specialists. On the other side, it suggests that spotted owls show adaptive responses to regional variation in environmental conditions. Regional variation in habitat selection by owls does not indicate that they will respond positively to any human-induced habitat changes in one part of their range that lead to habitat conditions similar to those used by owls in other parts of their range. An additional problem in assessing variation in habitat use is the lack of a consistent definition of vegetation seral stage classification (see Table F1 in Thomas et al. 1990). Terms such as "old-growth, mature, young age, unmanaged, managed, second-growth" are defined in the literature using different parameters and criteria. This impedes rather than facilitates communication among interested persons.

Owls in managed forests within the California Klamath and California Coast provinces usually occupy stands with high structural diversity, high canopy closure, and either large-diameter trees or residual old trees (Appendix B). These stands are usually more than 60 years old after partial logging events of the past (Thomas et al. 1990). For example, stands in the redwood region of the California Coast province described by Kerns (1989) have a structure similar to unmanaged (i.e., not previously logged) mature stands occupied by owls in a nearby national forest (Solis and Gutiérrez 1990). Apparently, the fast growth of redwood trees, presence of understory hardwood trees, and the remnant old trees within the stands facilitate rapid structural development of these coastal forests. Critical aspects yet to be estimated in previously harvested forests are the survival, recruitment, dispersal, and reproductive patterns of these birds relative to conspecific populations in unlogged forests.

Home Range Size

Home range is defined generally as the area used by an animal and to which the animal exhibits fidelity. The size of home ranges of spotted owls is a focal point of controversy because of their large size (Table 2.1; Thomas et al. 1990).

Forsman (1980) was the first to critically estimate spotted owl home range size by using radio telemetry, although Marshall (1957) guessed at the nightly ranges of Mexican spotted owls in Arizona and Mexico. Radio telemetry is the only method through which scientists reasonably can estimate the size of spotted owl home ranges. There has been some concern expressed about the effect of radio transmitters on survival and reproduction (Paton et al. 1991). Foster et al. (1992) found no significant differences in survival or body mass between radio-marked and unmarked spotted owls, although some owls did die as a result of improper transmitter attachment. But they did record a significant negative effect on reproductive output of radio-marked owls.

Because of Forsman's (1980) initial observations that spotted owl home ranges were very large (more than 2,000 acres on the average) a great deal of scientific effort has been devoted to verifying his original observations as well as estimating the geographic and inherent variation in spotted owl home ranges (Forsman 1981, Solis 1983, Forsman et al. 1984, Gutiérrez et al. 1984, Sisco and Gutiérrez 1984, Forsman and Meslow 1985, Allen et al. 1989, Hamer et al. 1989, Hays et al. 1989, Carey et al. 1990, Paton et al. 1990, Sisco 1990, Thrailkill and Meslow 1990). In addition, Thomas et al. (1990) summarized this information as well as other unpublished estimates of home range size (see Table 2.1).

Interpreting the variation in home range size and habitat use has been a significant challenge to spotted owl ecologists. Variation (i.e., the distribution of observations of a trait) in observed home range size has formed the basis upon which scientific inference and generalization were based about spotted owl home range requirements. From the studies cited earlier, some generalizations can be made about home range characteristics. First, all studies of home range size are consistent with Forsman's (1980) original observations of large spotted owl home ranges (see Table 2.1). Second, there is a large degree of overlap in home range areas between members of the same pair (Forsman et al. 1984, Solis and Gutiérrez 1990) and lesser overlap among adjacent pairs (Forsman et al. 1984). Third, there is considerable geographic variation in home range size, with owls occupying Washington's Olympic Peninsula having the largest home ranges (Thomas et al. 1990). Fourth, home range size increases as the amount of old forest within the home range decreases (i.e., loss of habitat from logging; Carey 1985, Forsman et al. 1984, Thrailkill and Meslow 1990). It is unknown if this geographic variation is related to latitude, habitat, individual, temporal, or prey-base variation.

The size of an owl's home range probably is dependent on many factors (e.g., food availability, interspecific competition, amount and arrangement of suitable habitat). For example, spotted owl home range size may be a reflection of an adaptive response to low prey abundance and variation in abundance and distribution of prey (Ward 1990). Further, estimates of owl home range size can be influenced by the sampling design of the home range study and the home range estimator used in the analyses (Carey et al. 1989, Call 1989). Although these factors may influence the estimation of owl home range size, predictions of home range sizes of birds of the size and trophic level of spotted owls based on allometric equations are similar to empirical estimates of spotted owl home ranges (Schoener 1969). Predictions of spotted owl home range size, based on allometric analysis of mammals, underestimate direct observations of

Table 2.1. Median annual home range areas (in acres) of spotted owl pairs in different study areas and physiographic provinces.^a

State	Location Site	No. of Pairs	Forest Type ^b	Range			Sources ^c
				Median	Min	Max	
California							
	Klamath Mountains						
	Ukonom	9	MC	3,314	2,056	7,823	1
	Mad River	12	MC	2,975	1,803	4,685	1
	Willow Creek	2	MC	1,692	1,258	2,126	2
Oregon							
	South Coast						
	Chetco	4	MH	5,614	5,327	6,197	1
	Klamath Mountains						
	South Umpqua	3	MC	1,411	1,035	1,504	3
	Cow Creek	6	MC	4,106	2,499	7,494	3
	Coast Ranges						
	Tyee	5	DF/HEM	3,387	1,880	8,272	3
	Peterson	4	DF/HEM	6,318	3,483	10,189	3
	Eugene BLM	4	DF/HEM	6,390	3,715	8,180	4
	Other ^d	4	DF/HEM	4,183	2,849	9,748	5
	Kellogg ^e	5	MC	4,072	1,618	6,281	3
	Western Cascades	11	DF/HEM	2,955	1,443	9,758	6,7
Washington							
	Western Cascades	11	DF/HEM	6,657	2,969	17,942	8,9,10
	Olympic Peninsula	10	HEM/DF	14,271	4,497	27,309	9,11

(Note -Table follows Thomas et al. (1990) with changes based on Forsman and Hays (pers. comm.))

^aPair ranges were calculated by delineating 100 percent MCPs (minimum convex polygons): total = exclusive area of male + exclusive area of female + the area of overlap shared by the two sexes.

^bMC = mixed conifer, MH = mixed conifer/evergreen, DF/HEM = Douglas-fir, western hemlock, HEM/DF = mostly western hemlock with Douglas-fir intermixed.

^c1 = Palon et al. (1990), 2 = Solis (1983), 3 = Carey (pers. comm.), 4 = Thraill and Meslow (pers. comm.), 5 = Carey et al. (1989), 6 = Forsman and Meslow (1985), 7 = Miller (pers. comm.), 8 = Allen et al. (1989), 9 = Hays et al. (1989), 10 = Hamer (pers. comm.), 11 = Forsman (pers. comm.).

^dIncludes four sites in the southern Coast Ranges near Roseburg.

^eThis was a relatively dry area bordering the Umpqua River Valley, characterized by mixed conifer forest more typical of the Oregon Klamath province than the Coast Ranges.

owl home ranges (Harestad and Bunnell 1979, Lindstedt et al. 1986). Thus, because spotted owls do not fit theoretical predictions of their home range size based on mammalian allometric analysis, it should not be expected that they can survive and reproduce in a much restricted home range based on extrapolation from studies of mammals (SOW 1991).

One important feature of an owl's home range is the amount of suitable habitat within the boundaries of the home range. Thomas et al. (1990) summarized the amounts of old-growth and mature forest within spotted owl pair home ranges (see Table 2.2). The median amount of these late seral stage forests for a number of studies within the northern spotted owl's range was 615 to 4,579 acres. In only three studies were median amounts of these forest less than 1,000 acres. In one of these studies (Solis 1983), the sample was small (two

Table 2.2. Median amounts of old-growth and mature forest (in acres) in annual pair home ranges of spotted owls, by state and physiographic province.

State	Location Site	Number of Pairs	Forest Type ^b	Range			Sources ^c
				Median	Min	Max	
California							
	Klamath Mountains						
	Ukonon	9	MC	2,484	1,030	5,654	1,2
	Mad River	12	MC	1,365	835	1,953	1,2
	Six Rivers National Forest	2	MC	800	367	1,233	3
Oregon							
	Klamath Mountains						
	South Umpqua	3	MC	615	563	768	4
	Cow Creek	6	MC	1,549	1,450	1,983	4
	Coast Ranges						
	Tyee	5	DF/HEM	2,031	1,645	3,984	4
	Peterson	4	DF/HEM	2,609	1,284	3,196	4
	Eugene BLM	4	DF/HEM	1,783	799	3,580	5
	Other ^c	4	DF/HEM	2,375	1,795	2,625	6
	Kellogg ^d	5	MC	1,018	697	1,983	4
	West Slope Cascades	9	DF/HEM	1,796	1,050	3,786	7,8
Washington							
	West Slope Cascades	11	DF/HEM	3,281	1,715	8,998	9,10,11
	Olympic Peninsula	7	HEM/DF	4,579	2,787	8,448	12

(Note: -Table follows Thomas et. al. (1990) with changes based on Forsman and Hays (pers. comm.))

^aMC = mixed conifer, DF/HEM = Douglas-fir, western hemlock, HEM/DF = mostly western hemlock with Douglas-fir intermixed.

^b1 = Paton et al. (1990), 2 = Paton (pers. comm.), 3 = Solis (1983), 4 = Carey (pers. comm.), 5 = Thraikill and Meslow (pers. comm.), 6 = Carey et al. (1990), 7 = Forsman and Meslow (1985), 8 = Miller (pers. comm.), 9 = Allen et al. (1990), 10 = Hays et al. (1989), 11 = Hamer (pers. comm.), 12 = Forsman (pers. comm.).

^cIncludes four sites in the southern Coast Range near Roseburg.

^dThis was a relatively dry area bordering the Umpqua River valley, characterized by mixed conifer forest more typical of the Oregon Klamath province than the Coast Ranges.

pairs) and the pairs were sampled only for a short time. Thus, both the home ranges and the amount of late seral stage habitat of the study birds were likely to have been underestimated. In any event, the object of Solis' (1983) study was to quantify owl habitat structure and not to provide an accurate estimate of home range size. In the second study (Carey in Thomas et al. 1990:197), the sample of pairs was small and the study was located in an area of clumped habitat distribution. In a third study, Kerns (1989) reported on the habitat use of eight spotted owls occupying "managed" redwood forest with less than 1 percent old-growth, although he did not estimate home range sizes of his marked owls. However, stands used by owls in Kern's (1989) study often contained residual old-growth trees and also had a structure similar to mature forests.

Some animals do not exhibit fidelity to an area, and are considered to be nomadic. Juvenile animals often wander widely in search of a secure home range. Such wandering animals are engaging in dispersal. Some birds may move within or among the territories of other birds, without exhibiting fidelity

to any particular area. These birds often are referred to as "floaters." The ecology of floaters is critical to understanding the dynamics of spotted owl populations, but we know the least about them (Franklin In Press).

Food Habits

Diet: Although spotted owls take prey from a broad array of taxa (e.g., mammals, birds, insects), they primarily eat small mammals (Marshall 1942, Barrows 1980, 1985, 1987, Solis 1983, Forsman et al. 1984, Laymon 1988, Richards 1989, Thraillkill and Bias 1989, Ward 1990). Three mammal species, woodrats (*Neotoma fuscipes* and *N. cinerea*) and flying squirrels (*Glaucomys sabrinus*), compose the majority of the prey biomass eaten by these owls (Solis 1983, Forsman et al. 1984). One of these species usually dominates the diet in an area, and this regional variation in diet is related to habitat and the distributional limits of the prey species (Forsman et al. 1984, Thomas et al. 1990).

Barrows (1985, 1987), Laymon (1988), and Thraillkill and Bias (1989) reported that the diet of breeding owls was dominated by larger prey (i.e., woodrats) whereas nonbreeding owl diets were characterized by smaller prey species. This suggested a strong ecological or evolutionary relationship between spotted owls and these larger small mammal species. Unfortunately, the small sample of owls among these studies precludes strong inference about these relationships. Thomas et al. (1990) also pointed out that large prey may be transported at a higher rate to nest sites than smaller prey. In addition, Ward (1990) and Forsman et al. (pers. comm.) were unable to document this relationship.

Spotted owl prey: Strong functional responses between prey and a variety of owl species have been demonstrated in both North America and Europe (Southern 1970, Rusch et al. 1972, Adameik and Keith 1978, Sonerud et al. 1988, Saurola 1989). It is surprising, therefore, that until recently, little research effort has been devoted to understanding spotted owl prey and ecological responses of spotted owls to their prey. Most prey studies have been concerned with patterns of abundance and distribution of small mammals within the range of the owl (summarized by Thomas et al. 1990). One study, (Ward 1990), has related variation in prey abundance and distribution to owl reproductive success and hunting behavior, although several studies linking prey and spotted owls have been undertaken (Thomas et al. 1990). In Ward's (1990) study, woodrats were the primary prey. Spotted owls foraged in areas where the abundance of woodrats was less variable. This suggests that the owls may have been optimizing their search effort. That is, they were foraging in stands that did not necessarily contain the most abundant woodrats, but they hunted in areas where the occurrence of the animals was more predictable. Ward (1990) also showed that not only was prey abundance low but also that prey populations were variable across the landscape. These limited observations help explain the large home range sizes observed among spotted owls.

Availability of spotted owl prey has been advanced as an explanation for the occurrence of spotted owls in old-growth/mature forests (Forsman 1980, Forsman et al. 1984; also see Carey 1985, Gutiérrez 1985). Northern flying squirrels clearly depend on forest communities, but woodrats do not. Woodrats are more abundant in early seral stage vegetation (e.g., brushy areas) than they are in old-growth forests (Thomas et al. 1990). Yet spotted owls spend little time hunting in clear-cuts (Forsman et al. 1984, Solis 1983). This unpredicted foraging behavior may be related to the relative availability of woodrats to predation in the two habitats. That is, in the dense vegetation of early shrub dominated seral stages, spotted owls may not be able to capture woodrats effectively. In the more open older forests, spotted owls may be more effective predators even though the woodrats are less abundant. Thus, we

cannot reject the hypothesis that prey availability explains spotted owl selection for older age forests. In addition, if they feed in open areas, spotted owls may be killed by great horned owls (Forsman et al. 1984).

3. Life History

Reproductive Biology

Nesting phenology: Spotted owls begin their annual breeding cycle in late winter (February or March) when the pair begins to roost together. Copulation occurs during this nuptial phase (Forsman et al. 1984). Some owl pairs use the same nest site repeatedly, some use new ones each year, and others alternate nest sites from year to year. Once a clutch of eggs is laid, the female incubates the eggs for approximately 30 days (Forsman et al. 1984). After the eggs hatch, the owlets remain in the nest and usually are fed by the pair until they leave the nest. Juvenile owls leave the nest 3 to 5 weeks after hatching. Many abandon the nest site well before they are able to fly. They jump into the branches of surrounding trees or fall to the ground only to clamber up a leaning tree to a safe perch. The adaptive significance of this behavior is unknown, but Forsman et al. (1984) suggest that it serves to avoid increasing parasite loads in the nest as the season progresses. Once out of the nest the young owls are fed by the male and the female. They grow rapidly under good food conditions, reaching their parents' body mass prior to dispersal (Gutiérrez et al. pers. obser.). Although juvenile owls are dependent on their parents, they begin to hunt by late summer. Dispersal begins in the early fall, signaling the end of the annual reproductive cycle (Gutiérrez et al. 1985, Miller and Meslow 1985, Miller 1989). Therefore, spotted owls are considered to be "birth pulse" breeders (i.e., they have distinct annual breeding periods) (Caughley 1977). This knowledge is important when choosing an appropriate model with which to derive population projections.

Variation in clutch size and nesting success: Spotted owls have one of the lowest clutch sizes among North American owls (Johnsgard 1988). Normally, spotted owls lay one or two eggs (Forsman et al. 1984). A small proportion of the population will lay three-egg clutches. Records of four-egg clutches are rare (Bendire 1892, Dunn 1901). Because clutch size is small there is relatively little variation in the number of eggs laid by a female. However, there is large variation in nesting success and in the proportion of the population that breeds over time and among regions (Forsman et al. 1984, Gutiérrez et al. 1984, Thomas et al. 1990, Lutz 1992, LaHaye et al. In Press). Nesting success within a population can range from 0 to 100 percent (Forsman pers. comm., Gutiérrez et al. 1984, Gutiérrez 1991 pers. comm.). Interestingly, Franklin et al. (1990a) reported little variation in nesting during a 6-year study in northwestern California.

Fecundity: Technically speaking, fecundity is the number of female young produced per female (Caughley 1977). However, the term has been used in a variety of ways in wildlife literature. Fecundity usually is defined relative to females because it is the female segment of the population that is mathematically modeled to project population trends. Because reproductive activity varies greatly, fecundity also varies. Since biologists assume there is a 50:50 sex ratio (Noon and Biles 1990, Thomas et al. 1990, USDI 1990) in a spotted owl population, fecundity in owl populations is almost always between 0.1 and 1.5 (Thomas et al. 1990, Forsman 1988a, Franklin et al. 1990a, Lutz 1992, LaHaye et al. In Press).

Age at first reproduction: Spotted owls can breed as early as 1 year old (Barrows 1985, Miller et al. 1985). Yet most birds probably do not breed before

they are 3 years old (Franklin et al. 1990a, Thomas et al. 1990). In addition, subadult owls have lower fecundity than do adults (Franklin et al. 1990a). Age-specific fecundity also is an important demographic parameter, but there are no age-specific estimates of fecundity for the adult age classes. Therefore, for purposes of demographic modeling, adult fecundity is assumed to be equal across age classes.

Survivorship

Adult rates: Adult northern spotted owls' annual survival rates are very high. Thus, they must be long-lived birds. Based on banding and radio telemetry, the chance of an owl living from one year to the next is 81 to 96 percent (Barrowclough and Coats 1985, Lande 1985, Franklin et al. 1990a, Thomas et al. 1990). In short-term studies, survival rates may vary as a response by birds to varying environmental conditions (Gutiérrez and Pritchard 1990, LaHaye et al. In Press). Thus, in long-lived species, studies must be of long duration to achieve reliable estimates of age-specific survival rates. The most recent estimates of survival are in Appendix C.

Subadult survival: Subadult owls have a lower survival rate than adult owls (Franklin et al. 1990a, Thomas et al. 1990)(Appendix C). Since subadults also have lower reproductive rates and fecundity, it may be possible that the same environmental or behavioral factors influence all aspects of the demography of the subadults in the same way. Nevertheless, the subadult segment of the population is relatively small and makes only a modest contribution to the dynamics of the population (Noon and Biles 1990, Thomas et al. 1990).

Juvenile survival: Juvenile survival rates have been measured from banded birds and radio-marked birds (Barrowclough and Coats 1985, Gutiérrez et al. In Prep.). Survival rates for this age class are low (the chance of a juvenile living from one year to the next is 15 to 29 percent) relative to adult survival rates (Thomas et al. 1990). It is well known that first-year birds, in general, have low survival. The rigors of dispersal and the consequences of inexperience (e.g., poor hunting skills, lack of familiarity with a territory) lead to higher mortality rates.

Mortality: Spotted owls die from a variety of causes. The most frequent cause of mortality recorded among radio-marked birds is predation by other animals (Johnson pers. comm.). They also die from accidents (e.g., flying into objects, automobiles, and drowning) (Gutiérrez et al. 1985, Franklin, LaHaye, Gutiérrez pers. comm., Johnson pers. comm.). Accidents are considered to be density-independent, whereas predation usually is density-dependent in most prey, although predation may be density-independent in spotted owls. Another source of mortality is starvation. Starvation is common among spotted owls (Gutiérrez et al. 1985, Miller 1989, Johnson pers. comm.), but occurs less frequently among adult spotted owls (Sisco 1990). Starvation could be a consequence of low prey abundance, low prey availability (i.e., poor hunting habitat), or inexperience (inability to hunt successfully).

Density

The number of northern spotted owls is a topic of much debate (Thomas et al. 1990). With increasing survey and monitoring of populations, the number of known owls has increased greatly since the first estimates of total abundance were made. These observations of higher owl abundance reflect greater knowledge and effort expended by biologists to count owls; these observations should not be interpreted as evidence that the owl population is increasing. The total abundance of owls appears to be declining gradually over time (Forsman et al.

1984, Thomas et al. 1990, USDI 1990). One important step toward estimating the number of owls is to estimate their density. The density of an animal population is the number of individuals per unit area. Once an estimate of density is derived, the estimate can be used to compute an estimate of abundance for all of the area containing similar habitats or environmental conditions.

Census and monitoring of northern spotted owls have been a high priority with land management agencies and research scientists (O'Halloran 1989, Simon-Jackson 1989, Azuma et al. 1990, Max et al. 1990, Franklin et al. 1990b, Thomas et al. 1990, Ward et al. 1991). Franklin et al. (1990b) estimated the density of spotted owls in northwestern California to be 0.65 owls per square mile. They also estimated the density of owls within suitable habitat; this value was 1.51 to 1.83 owls per square mile, depending on the method used to estimate the density. Using their estimates of density, they projected declines in spotted owl populations between 60.0 percent and 82.5 percent in their area if proposed management scenarios (USDA 1988) were implemented.

Densities of spotted owls vary across their range as a function of habitat quality, geographic province, and current environmental conditions (Forsman et al. 1977, Franklin et al. 1990b, Gutiérrez and Pritchard 1990, Lutz 1992, Ward et al. 1991, LaHaye et al. In Press). Although much emphasis is placed on density, high densities can be mistaken as evidence of high quality habitat (Van Horne 1983). Density estimates are useful for relative comparisons and for evaluating management objectives, but they must be used in conjunction with knowledge of corresponding survival and fecundity values for the populations (see Habitat about spotted owl use of young, managed timberlands).

Dispersal

Dispersal among vertebrates is the process of an animal leaving one area to establish a new home range in another area. Dispersal can be undertaken by juvenile or adult spotted owls. Further, dispersal is often characterized as effective (i.e., successful breeding occurs at the end of the dispersal event) or gross (i.e., breeding may or may not be successful following dispersal) (Greenwood 1980). Scientists know a great deal more about the process and pattern of juvenile spotted owl dispersal than of adult dispersal, despite the difficulty of closely following large numbers of dispersing juvenile owls (Gutiérrez et al. 1985, Miller and Meslow 1985, Miller 1989, Gutiérrez et al. In Prep.).

Gutiérrez et al. (1985), Miller (1989), and Gutiérrez et al. (In Prep.) used radio telemetry to estimate patterns of gross juvenile dispersal. Juvenile spotted owls dispersed from their natal areas in September and October after they had reached adult body mass (Gutiérrez et al. 1985, Miller 1989). They apparently left their natal areas in random directions (Gutiérrez et al. 1985, Gutiérrez et al. In Prep.), and traveled moderate distances (approximately 9 to 30 miles on average) during their first autumn (Gutiérrez et al. 1985, Miller 1989, Gutiérrez et al. In Prep.). The pattern of dispersal varied among cohorts in a variety of ways including differences in direction, distance, and survival (Gutiérrez et al. In Prep.). Effective dispersal distance, estimated from returning banded birds averaged about 4 miles for juvenile male spotted owls and about 12 miles for female juveniles (Gutiérrez et al. In Prep.). Dispersal distances from banded birds were slightly higher for Oregon owls (Johnson pers. comm.). Estimates of dispersal distance based on studies with finite area size have been shown to be underestimates of true dispersal distance (Barrowclough 1980).

Adult spotted owls will leave mates or move from territories, but the causes of these adult dispersal events are unknown. Spotted owls normally form long,

stable pair bonds because the number of recorded adult dispersals is low. Also, the conditions surrounding these observations of adult dispersal events have not been summarized.

Demographic Projections

Because spotted owls are long-lived animals, the status of their populations is difficult to estimate. Thus, mathematical models are used to project population trends using estimates of the vital rates described earlier. Models can be deterministic (linear projections based on the estimates of the vital rates) or stochastic (projections based on random variation of specific rates or conditions). Stochastic models generally are considered to be more sophisticated because they are more complex, and they simulate variation that would be expected in natural environments. Models of both kinds have been used to evaluate spotted owl population dynamics and dispersal (Boyce 1987, Marcol and Holthausen 1987, USDA 1988, Doak 1989, Lande 1988, Noon and Biles 1990, Thomas et al. 1990, USDI 1990, Lutz 1992, Franklin In Press, Lamberson et al. In Press, LaHaye et al. In Press). In addition, Shaffer (1985) suggested that metapopulation models, in which species have populations discontinuous in time and/or space, be used to evaluate spotted owl population dynamics. Almost all modeling projections indicate that spotted owl populations are declining. However, Boyce (1987) criticized the first attempt to use a stochastic model for projecting population trends (USDA 1988) because the model did not incorporate density dependence. Density dependence is the functional response in survival probability and/or fecundity of a population to variation in density. That is, as a population declines, the density declines. Presumably, the remaining individuals in the population have more resources available to them per capita (i.e., there is less competition) and these resources then can be used by the survivors for reproduction and other life functions. Boyce (1987) argued that if a population declines numerically there should be a density-dependent response in the owl population, which would mitigate the lower density and serve to stabilize the population. In the case of the spotted owl, density has not been declining, only the abundance of owls, because habitat loss is the causative mechanism for the decline. Thus, when Thomas et al. (1990) incorporated density dependence into their metapopulation model, the projected population decline was more rapid. Most estimates of changes in northern spotted owl populations indicate that populations are declining throughout their range (Appendix C).

Models also can be spatially explicit. They can incorporate the influence of landscape character on the underlying population dynamics (Lamberson et al. In Press, Lamberson and Brooks 1991). These models are useful for developing a more complete range of alternative hypotheses to account for observed phenomena. For example, the recent observations of abundant owls in the California Coast province could be a reflection of good habitat for owls, which results in high productivity and high survival among the owls. Or alternatively, the dynamics of these redwood zone, coastal owl populations could be the result of immigration of owls from adjacent old-growth/mature forests in national forests in the Klamath province (Lamberson and Brooks 1991). The model illustrates the importance for recovery of the spotted owl throughout all of the provinces within its range (i.e., recovery of the owl in the California Klamath province probably could not be achieved if there were not a concomitant recovery in the California Coast province).

4. Conclusion

Our knowledge of the natural and life history of the northern spotted owl has grown tremendously in the past 10 years. Unlike data available on many threatened and endangered species, we have preliminary information on the demography of the owls so that initial projections of populations can be made. However, because the bird is long-lived, estimates of vital rates and, therefore, estimates of lambda (a population's finite rate of growth) may change as the populations are followed through time. These changes will occur because of normal population responses to good and poor environmental conditions as well as to habitat changes. It is evident that much more needs to be learned about the species (and other late seral stage species) to allow us to refine management plans compatible with the ecology of the species. Nevertheless, more is known about this species than about most endangered or threatened species.

II.

B. Status and Threats

The present range of the northern spotted owl approximates the limits of its historic range. The range extends from southwestern British Columbia south through the coastal mountains and the Cascade Range of Washington and Oregon, and into northwestern California as far south as San Francisco. Although the total area of the subspecies' range has not decreased, its distribution has changed greatly. The Puget Trough in Washington and lands adjacent to the Willamette Valley in Oregon no longer support populations of owls because of loss of habitat to urban, rural residential, and agricultural development. In southwestern Washington and northwestern Oregon, timber cutting and wildfires have greatly reduced habitat, and spotted owl populations are very low at present. In British Columbia, only some 20 pairs are known to exist; much of the owl's range in Canada has been logged, and little mature and old-growth forest remains.

Abundance, distribution, and habitat use of the spotted owl vary across the forest zones that occur within its range. Physiographic provinces as described by Franklin and Dyrness (1973) incorporate the physical and environmental factors that shape the landscape of the Pacific Northwest. These physiographic provinces were modified by Thomas et al. (1990) and, with slight further modification, were adopted by the Recovery Team to describe the range of the spotted owl (Figure 2.2).

1. Habitat Status

The extent of owl habitat that existed prior to logging is unknown, but by the early 1980s more than 80 percent of prelogging old-growth had been removed (Booth 1991). Although not all old-growth forests are suitable spotted owl habitat (e.g. high elevation forests), this great decrease suggests that the 7.6 million acres of habitat that remain today represent only a small portion of the area formerly occupied by spotted owl habitat (USDA 1991). Suitable habitat on national forests currently is declining about 1 to 2 percent annually. Mulder et al. (1989) projected that almost all suitable spotted owl habitat on lands suited for timber production would be gone in about 60 years on national forests and in about 30 years on BLM lands.

Remaining suitable owl habitat is not distributed evenly over the range of the species. Habitat reduction has been greatest at low elevations and in the Coast Ranges of Oregon and Washington, and this reduction is reflected in low populations of spotted owls in those areas. Remaining habitat at higher elevations may be of lower quality than that which historically was present on low-elevation lands (Thomas et al. 1990). Thus, the approximately 50 percent of remaining spotted owl habitat currently in reserved areas or in areas unsuited for timber production (Table 2.3) may not contribute proportionally to productivity, because these lands are commonly at higher elevations.

Most remaining suitable habitat is found on federal lands. The Forest Service manages about 74 percent of this habitat, the BLM about 12 percent, and the National Park Service about 7 percent. In northern California, as much as 40 percent of spotted owl habitat may be on private lands, especially along the Coast Range (Gould pers. comm.). In Oregon and Washington, however, more than 95 percent of the estimated acreage of remaining owl habitat is found on federally managed lands.

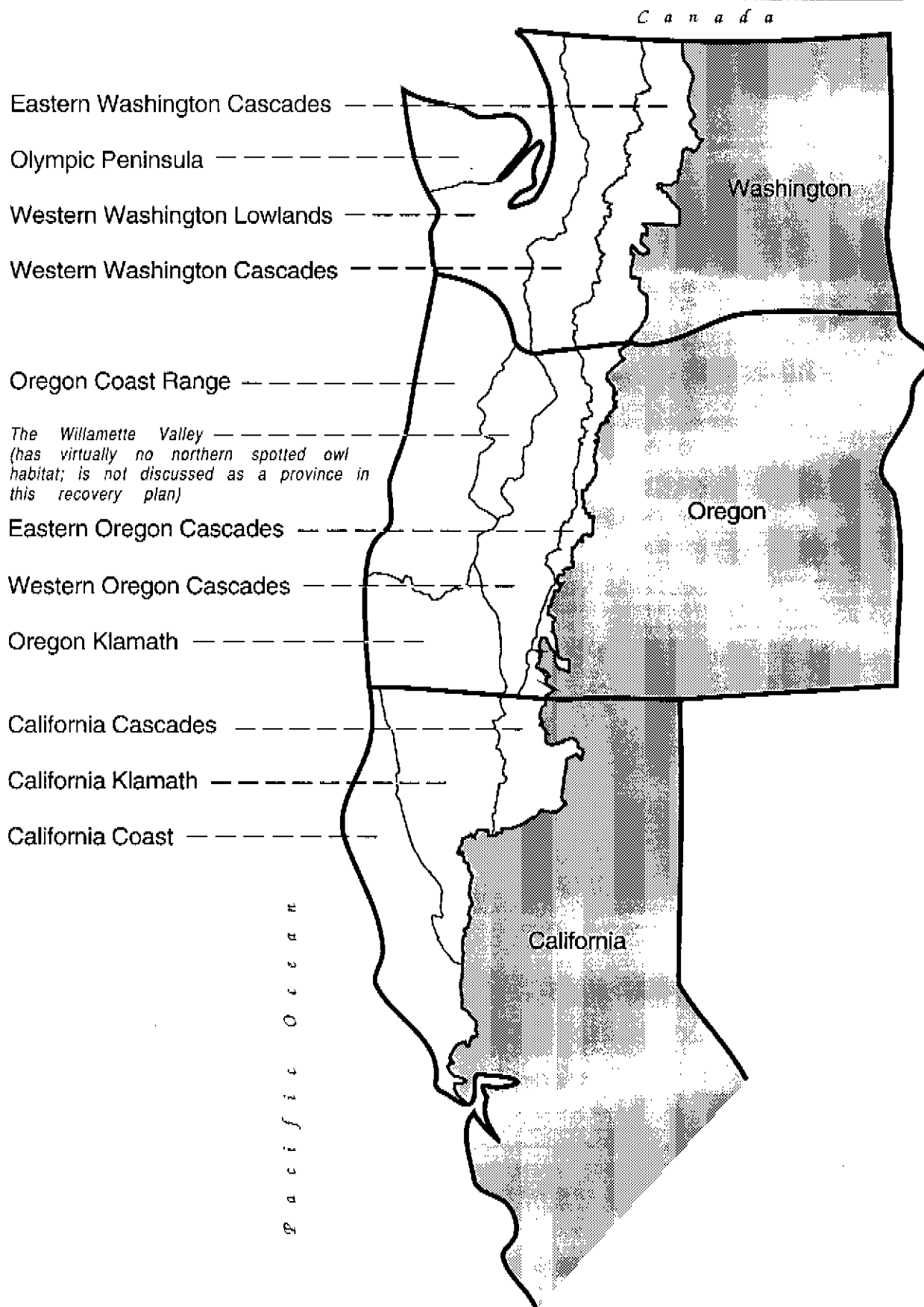


Figure 2.2. Provinces within the range of the northern spotted owl in the United States.

2. Population Status

There are no estimates of the historical population size of the northern spotted owl, but owls are believed to have inhabited most old-growth forests throughout the Pacific Northwest and northwestern California, and they still are found within their historical range in most areas where suitable habitat remains (Thomas et al. 1990).

Northern Washington and southern British Columbia represent the northern extent of the range of the owl. Population densities and numbers are lowest in these areas, with fewer than 20 pairs located in extensive surveys along the U.S. border with British Columbia (Dunbar 1990). A small, potentially isolated population of about 125 known pairs of spotted owls is located on the Olympic Peninsula in and around Olympic National Park (Fredrickson et al. 1989, Washington Department of Wildlife (WDW) 1991). Fewer than 50 owls have been located in recent extensive surveys in the Coast Ranges of southwestern Washington and northwestern Oregon north of Corvallis (Forsman 1986, Forsman et al. 1987, Irwin et al. 1989b, Oregon Department of Fish and Wildlife (ODFW) 1991). Populations also decrease in size and density from the Mendocino National Forest south to Point Reyes, California, and from the Klamath province east to the area of contact with the California subspecies in the Sierra Nevada Range (Gould pers. comm.).

Most of the present population of owls is found in the Cascades and Klamath provinces in Oregon, and in the Klamath and Coast Range provinces in northwestern California (Advanced Sciences Inc. 1989, Beak Consultants 1989, Brown 1989, Diller 1989, Irwin et al. 1989c, Kerns 1989a and 1989b, Pious 1989, ODFW 1991, WDW 1991). Distribution of remaining habitat is similar to the present distribution of spotted owls.

More than 86 percent of currently known pairs of owls has been observed on federally managed lands. The distribution of these pairs varies widely by land ownership, state, and physiographic province (Table 2.3). Although inventories are least complete in California, about 30 percent of the habitat and population of spotted owls may occur in the Coast Range (Gould pers. comm.).

Only population data gathered during a 5-year period were analyzed during the development of the recovery plan because they may provide more reliable estimates of actual numbers than longer cumulative periods or single-year counts, given the rapidly changing quantity and quality of habitat. It is also the period with the most intense inventories, and is within the average life span of the species (about 8 years). Depending on availability of data, the period used was either 1986 through 1990 or 1987 through 1991 (see Table 2.3).

Inventories from 1987 through 1991 indicate a total of about 3,500 known pairs of northern spotted owls in Washington, Oregon, and northern California (Table 2.3). This number is a minimum estimate of the true population size. The actual number of spotted owls remaining is unknown.

3. Significant Threats to the Northern Spotted Owl

Table 2.4 provides a summary of significant threats to northern spotted owl populations by physiographic province. Threats were characterized as follows:

Severe: The problem poses a severe threat to the population at the current time or will pose such a threat within the next several generations. The likely consequence is failure to maintain a population distrib-

Table 2.3. Estimated spotted owl habitat and number of pairs of spotted owls located during a 5-year period on all lands in Washington, Oregon, and California.

Landowner or Agency ^a	Estimated Acres of Spotted Owl Nesting, Roosting, and Foraging Habitat by Timber Capability				Owl Pairs		Totals
	Reserved ^b	Unsuitable for Harvest ^c	Suited for Harvest	Total Acres	Reserved	Non- reserved ^d	
FS, Washington	500,024	804,000	747,000	2,051,024	56	417	473 ^f
FS, Oregon	389,974	1,058,000	1,447,000	2,894,974	89	1,242	1,331 ^f
FS, California	304,268	519,000	305,000	1,128,268	64	550	614 ^f
BLM, Oregon	158,000	—	873,472	1,031,472	1	540	541 ^e
BLM, California	13,000	—	6,000	19,000	0	11	11 ^e
NPS, Washington	480,000	—	—	480,000	31	0	31 ^e
NPS, Oregon	50,000	—	—	50,000	4	0	4 ^f
NPS, California	40,000	—	—	40,000	2	0	2 ^e
Indian lands, Washington	NA	NA	257,000	257,000	0	51	51 ^f
Indian lands, Oregon	NA	NA	54,000	54,000	0	18	18 ^f
Indian lands, California	NA	NA	32,000	32,000	0	28	28 ^f
FWS, Washington	1,700	NA	5,000	6,700	0	0	0 ^f
FWS, Oregon	4,100	NA	NA	4,100	0	0	0 ^f
WDNR	NA	NA	NA	NA	0	33	33 ^f
WDW	0	NA	5,000	5,000	0	0	0 ^f
State parks, Washington	2,000	0	0	2,000	0	0	0 ^f
Cities of Seattle, Tacoma, Washington	0	0	1,500	1,500	0	0	0 ^f
ODF	0	NA	77,200	77,200	0	30	30 ^f
State parks, Oregon	8,000	0	0	8,000	2	0	2 ^f
Counties and cities, Oregon	NA	NA	NA	NA	1	0	1 ^f
CDF	NA	NA	NA	NA	0	4	4 ^e
State parks, California	56,000	0	0	56,000	0	10	10 ^e
BLM/TNC, California	6,500	0	0	6,500	0	0	0 ^e
NAS, California	600	0	0	600	0	0	0 ^e
Private, California	NA	NA	NA	NA	NA	235	235 ^e
Private, Oregon	NA	NA	NA	NA	0	50	50 ^f
Private, Washington	NA	NA	NA	NA	0	31	31 ^f
Totals	2,014,166	2,381,000	3,810,172	8,205,338	250	3,250	3,500

NA = Reliable estimates not available.

^aInformation obtained from landowners or state wildlife agencies.

^bWithdrawn from timber harvest (e.g., wilderness, national park, research natural area).

^cLands unsuitable for timber production because of allocation to other uses by land management plans, or technically unsuitable for timber production because of soils problems or difficulty of regeneration.

^dOwl pairs that are not on lands not withdrawn from timber harvest or that are on lands withdrawn on an interim basis.

^eFive-year survey period = 1986-1990.

^fFive-year survey period = 1987-1991.

FS = U.S. Forest Service

BLM = U.S. Bureau of Land Management

NPS = National Park Service

DNR = Washington Department of Natural Resources

WDW = Washington Department of Wildlife

ODF = Oregon Department of Forestry

NAS = National Audubon Society

TNC = The Nature Conservancy

CDF = California Department of Forestry and Fire Protection

Note: Numbers used in this table contain updates that were not available for the mapped data used in the geographic information system (GIS). Numbers cited elsewhere in the document were derived from the GIS and are not identical to numbers in the table.

uted across the range of ecological conditions in the province and the significant reduction of linkages and demographic support to adjacent provinces.

Moderate: The threat is not severe at the present time but would be expected to become severe within the next 10 generations if corrective measures are not undertaken. In most cases, these corrective measures will have to include actions to reverse present conditions and trends.

Low: The threat to the population is currently low and is expected to remain low as long as conservation measures are undertaken.

Unknown: Inadequate information currently exists to assess the threat. Not all threats are equally important, and no attempt was made to assign them weights. Comparisons between provinces cannot be based simply on the number of threats that fall in specific categories, e.g., the number of threats rated severe or moderate.

Low Populations. Small populations are vulnerable to extinction from a number of causes. Random fluctuations in environmental conditions (environmental stochasticity) and age and sex structure of populations (demographic stochasticity), along with potential loss of genetic variability (genetic stochasticity) are most likely to influence small populations.

Declining Populations. Population trends for northern spotted owls have been difficult to estimate because many of the adult and subadult birds are probably nonterritorial and difficult to detect on surveys. These "floaters" may wait for several years for a territory to become available before they pair and begin reproducing. If a population is declining, the number of territorial birds is likely to remain nearly constant as long as floaters remain, because territorial birds that die are replaced rapidly from the pool of floaters. Thus, territorial birds are the only segment of the population that can be monitored effectively, but trends in this segment of the population do not necessarily provide an accurate estimate of trends in the overall population.

One way to solve this problem is by analyzing birth and death rates. These rates then can be used to calculate whether the population is declining. The analyses, because they depend on how birth and death rates vary with age, are often complex. The underlying principle, however, is simply that the birth rate equals the death rate in a stable population. If the birth rate is less than the death rate, then population size declines.

The 1990 Status Review (USDI 1990) provided estimates of the rate of population change for two populations, one in northern California and one in southern Oregon. Both populations were shown to be declining. By the fall of 1991, data from 2 more years were available from these areas, and data were also available from three other study areas (Figure 2.3).

At the request of the Recovery Team, a group of 12 researchers was convened at Colorado State University to analyze this new information. The results indicated that all five populations declined from 1985 to 1991 (Table 2.5). The estimated rates of decline varied from 7 to 16 percent and averaged about 10 percent. The analyses also suggested that the rate of decline may be increasing. Details of the analysis are summarized in Appendix C. These new estimates reinforce the widely held belief that populations of spotted owls are declining throughout all or most of their range.

Limited Habitat. Throughout much of the range of the northern spotted owl, habitat is highly fragmented and is resulting in decreased owl productivity and

Table 2.4. Significant threats to the owl, by physiographic province (S = Severe, M = Moderate, L = Low, U = Unknown).

Province	Threats				
	Low Population	Declining Population	Limited Habitat	Declining Habitat	Distribution
Eastern Washington Cascades	M	M	M	M	M
Western Washington ^a Cascades (South)	M	M	M	S	M
Western Washington Cascades (North)	S	U	S	S	S
Olympic Peninsula	S	M	M	M	M
Western Washington Lowlands	S	S	S	S	S
Oregon Coast	S	S	S	S	S
Western Oregon Cascades	L	M	L	M	L
Eastern Oregon Cascades	M	U	M	M	S
Klamath ^b (Oregon)	L	S	L	M	L
Klamath ^b (California)	L	M	L	M	L
California Cascades	S	S	S	M	S
California Coast	L	M	M	M	M

^aWestern Washington Cascades province divided into north and south portions to reflect differences in severity of threats.

^bKlamath province includes portions of Oregon and California, thus threats are shown by state.

Threats					
Province	Isolation	Predation	Competition	Conservation ^c Measures	Natural Disturbance
Eastern Washington Cascades	M	U	U	-	S
Western Washington ^a Cascades (South)	M	U	U	-	L
Western Washington Cascades (North)	S	U	U	-	L
Olympic Peninsula	S	M	U	-	S
Western Washington Lowlands	S	S	U	-	M
Oregon Coast	M	S	M	-	M
Western Oregon Cascades	L	M	M	-	L
Eastern Oregon Cascades	M	U	L	-	S
Klamath ^b (Oregon)	M	M	M	-	M
Klamath ^b (California)	M	L	M	-	M
California Cascades	M	L	M	-	L
California Coast	S	L	M	-	L

^aBecause of rapidly changing conservation measures, it is difficult to assess this threat, although it remains significant over much of the range of the northern spotted owl. See text for further discussion.

Table 2.5. Results of surveys for spotted owls, great horned owls, and barred owls in the range of the northern spotted owl. (Number of individual owls is shown in parentheses.)

Location/Province	Dates	Method of Enumeration	Spotted Owls	Great Horned Owls	Barred Owls	Sources
Southwest British Columbia	1985-1988	Responses to spotted owl calls from different sites	14	—	57	Dunbar et al. 1990.
Western Washington	1982, 1983	Responses to spotted owl calls	102	—	11	Hays et al. 1989.
Ross Lake Drainage, North Cascades National Park, Washington	1987	Responses to spotted owl calls	0	1	11	Bjorklund and Drummond 1987.
Wilderness in Wenatchee and Okanogan National Forests and North Cascades National Park, Washington	1989	Responses to spotted owl calls, some other owl calls, and "volunteer" responses	8	5	12	Irwin et al. 1989a.
Washington Cascades	1986-1989	Birds on 122-square-mile study area	(16)	(25)	(31)	Hamer et al. 1989.
Hoh-Clearwater, Olympic Peninsula, Washington	1988, 1989	Responses to spotted owl calls and "volunteer" responses	389	274	5	Anthony and Cummins 1989.
Western Washington Lowlands	1987, 1988	Responses to spotted owl calls, some other owl calls, and "volunteer" responses	58	279	17	Irwin et al. 1989b.
Washington Eastern Cascades (Yakima Reservation)	1991	Responses to spotted owl calls	58 (21)	70	3	Hanson, unpubl. data
Oregon Western Cascades	1989, 1990	Responses to spotted owl and great horned owl calls	294 (161)	193 (95)	27 (16)	Johnson, and Meslow unpubl. data
Central Oregon Coast Range	1991	Responses to spotted owl calls; 6 percent of 38,000 acres of state land in trees > 75 years	0	27 (10)	0	ODFW unpubl. data
Oregon Coast Range	1990, 1991	Responses to spotted owl and great horned owl calls	47 (18)	341 (118)	0 (0)	McGarigal, unpubl. data

dispersal success, as well as increased mortality. Individual pairs are becoming isolated in significant portions of most provinces. Provinces with 20 percent or less of potentially suitable habitat currently in suitable condition generally are considered to be under severe threat, and those with less than 40 percent in suitable condition generally are considered to be under moderate threat (Bart and Forsman 1992).

Declining Habitat. In the near future, continued loss of habitat at recent rates (1 to 2 percent per year) will likely accelerate current population declines. If habitat is already below critically low levels, the continued loss of potential habitat would further reduce management options and lengthen the time required to achieve recovery.

Distribution of Habitat or Populations. Within many provinces, populations and habitat are poorly distributed, so that owls are no longer present across the full range of ecological conditions (e.g., elevation zones) and populations are

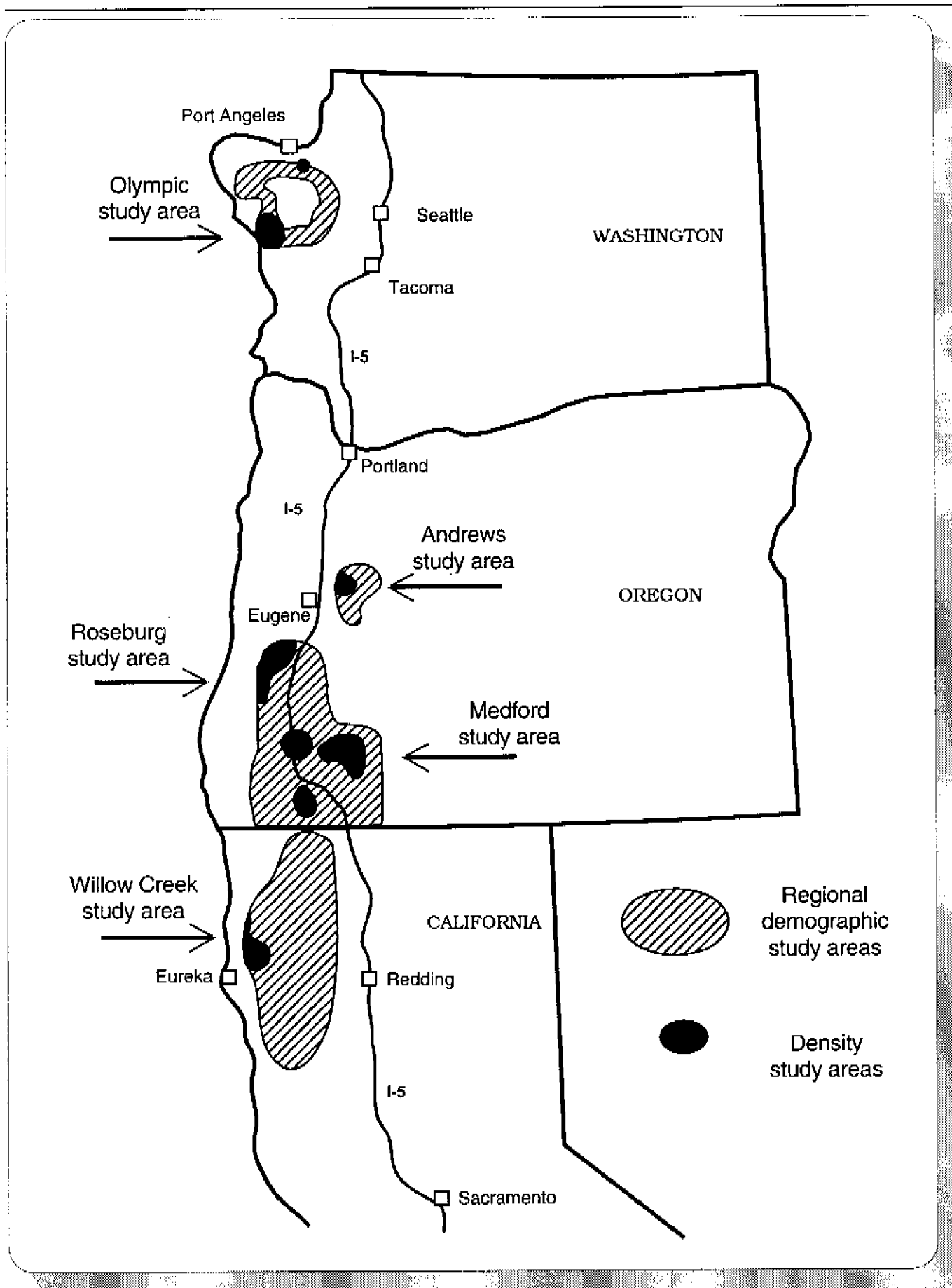


Figure 2.3. Demographic study areas.

isolated. In these provinces, small clusters of owls are separated widely by habitat unsuitable for dispersal, and populations are vulnerable to extinction from random demographic, genetic, and environmental events (Shaffer 1987).

As distance increases beyond 12 miles, the probability of interchange among clusters decreases rapidly (Thomas et al. 1990). Within provinces where spacing among patches of suitable habitat commonly exceeds this distance, persistence of clusters is threatened severely.

Isolation of Provinces. Small, isolated populations are vulnerable to adverse demographic and genetic effects, as well as the effects of large-scale disturbance. Adverse effects of isolation not only threaten subpopulations, but may exclude isolated populations from genetic interchange with a larger, interactive population.

Provinces can be isolated from some or all of the surrounding provinces by physical barriers (e.g., the Columbia River) and/or by distance between areas of suitable habitat. Immigration of only a few individuals per generation may be adequate to prevent deleterious genetic effects from inbreeding. However, immigration of a larger number of individuals may be needed for demographic rescue.

Predation and Competition. From 1975 to 1991, some 344 adult or subadult, and 85 juvenile spotted owls have been radio-tagged within the range of the subspecies (Johnson pers. comm.). Among these, 91 adults or subadults and 60 juveniles are known to have died. Forty percent of the adults or subadults, and 25 percent of the juveniles died from predation by other birds.

Key avian predators of spotted owls are the great horned owl (*Bubo virginianus*), goshawk (*Accipiter gentilis*), and red-tailed hawk (*Buteo calurus*). The common raven (*Corvus corax*) also is considered a predator, more likely preying on juvenile than adult spotted owls.

The great horned owl is the most commonly documented predator of spotted owls (Miller 1989). Great horned owls have become more abundant throughout much of the range of the northern spotted owl, although severity of this threat is difficult to measure. Relative densities of the two species in undisturbed landscapes are unknown, however ratios of great horned owl density to northern spotted owl density are highest in more fragmented portions of the northern spotted owl's range (Table 2.5). Johnson and Meslow (unpubl. data) found that great horned owls occupied areas that contained significantly less mature/old-growth forest and interior habitat; had greater edge-to-area ratios; had more shrub/forb, sapling, and shelterwood stands; and were more fragmented than those occupied by northern spotted owls.

Barred owls are expanding into areas occupied by northern spotted owls. For the period of 1980 to 1991, barred owls were reported from 17 locations in California, 260 locations in Oregon, and several hundred locations in Washington. Most of these observations occurred since 1985, and were made incidental to spotted owl surveys. Relative density of barred owls is high in many areas of the spotted owl's range (Table 2.5) and they are displacing spotted owls in some areas (Taylor and Forsman 1976, USDA 1988). Hybridization between the two species also has been documented.

Lack of Coordinated Conservation Measures. At the time of listing, the lack of effective regulatory provisions and conservation measures was judged to be one of the most significant threats to the northern spotted owl. Since that time, various conservation measures have been applied to federal and nonfederal lands. The Endangered Species Act prohibits actions that will result in taking owls, regardless of the land ownership on which the taking

occurs. The act also prohibits federal agencies from authorizing, funding, or carrying out action that would jeopardize a listed species, or destroy or adversely modify its critical habitat.

In addition to federal measures specifically protecting owls, the states are pursuing additional measures for owl conservation, and for wildlife habitat conservation in general (see section II.C.). These measures are developing rapidly and further change is expected. Various legal proceedings also have resulted in changes in management practices. Because of the differences in land ownership patterns, state regulatory mechanisms, and the pace of change, it is difficult to accurately quantify the impact of these conservation measures and the relative risk to the owl.

Despite these developments, the lack of effective, coordinated, rangewide conservation measures is one of the most significant threats to the northern spotted owl. The recovery plan will serve to integrate conservation measures now in place, and will provide biological principles to guide development and implementation of additional measures.

Vulnerability to Natural Disturbance. There is significant risk that fire, windthrow, insects, or diseases will reduce habitat, with effects on spotted owl populations. Although these disturbance events may occur in any of the provinces, the eastern Cascades of Oregon and Washington, and the Cascades and Klamath provinces of California are especially vulnerable (Appendix F).

Although fire currently may represent a threat to spotted owls, the habitat in which they evolved owed its structure and species composition to fire (Agee 1991a). Historically, owls occupied a dynamic landscape that often consisted of large areas of burned and unburned forest (Henderson 1990, Tecnisma et al. 1991). Populations undoubtedly shifted with the changing pattern of this landscape. Today habitat is greatly reduced and fragmented, and owl populations have become increasingly vulnerable to loss of habitat due to fire.

4. Threats by Province within Washington

Olympic Peninsula

The Olympic Peninsula is a relatively isolated province, bordered on three sides by bodies of water. A high mountain range encompasses the central portion of the peninsula and high-elevation ridges radiate from the central area throughout Olympic National Park and Olympic National Forest.

Currently, spotted owls generally are located in mid-elevation forests along major river systems draining the mountains. A smaller number of owls reside on primarily nonfederal lands at lower elevations in the western portion of the peninsula. Major threats to spotted owls on the Olympic Peninsula include low population levels and poor population distribution, habitat loss, isolation, and natural disturbances.

Low Populations. Population estimates for the Olympic Peninsula range between 175 and 225 current pairs, with 111 currently known pairs and 26 territorial singles on the Olympic Peninsula (WDW 1991). Survey intensity has varied among ownerships, with the most intensive surveys historically conducted in Olympic National Forest and the Hoh-Clearwater land block of the Washington Department of Natural Resources.

Private and other state lands received little survey effort until summer 1991, when more intensive survey efforts were undertaken. Currently, activity

centers for 30 to 35 spotted owl territories are located on state or private lands on the Olympic Peninsula, although additional owls with activity centers on federal lands likely utilize state and private lands. Most of the spotted owl sites located on nonfederal lands occur in the western portion of the province, north of the Quinault Indian Reservation.

Because of the roadless nature of Olympic National Park, spotted owl surveys are extremely difficult and only a portion of the park has been surveyed. Past population estimates for the park have been based largely on densities of owls in demographic study areas in adjacent Forest Service lands and Landsat analysis of amounts and distribution of suitable habitat within the park (Thomas et al. 1990). Estimates vary between 60 and 80 pairs in Olympic National Park. Approximately 45 distinct territories have been located in the interior portion of the park, with an additional eight territories in the narrow coastal portion.

The current estimated population of 200 pairs on the peninsula has a low likelihood of persistence during the next 100 years unless measures are taken to resolve the existing threats.

Declining Populations. High rates of habitat loss on nonfederal and national forest lands undoubtedly are reflected in spotted owl population declines. Since World War II, old-growth forest in Olympic National Forest has declined 76 percent (Morrison 1990). Large areas of habitat loss on the Olympic Peninsula include the Olympic National Forest Shelton Sustained Yield Unit, the Quinault Indian Nation, and the area of state and private ownership west of Forks and north to the Straits of Juan de Fuca. Northern spotted owls once inhabited these lower elevation areas, likely in high densities. Reproductive success has been highly variable in past years, and continued monitoring will be required for adequate trend assessment. However, populations in the Olympic Peninsula demographic study area are declining nearly 12 percent annually (Appendix C.).

Limited Habitat. Suitable habitat is highly fragmented at lower elevations on the Olympic Peninsula. Past habitat loss has likely resulted in low numbers of spotted owls on Indian, state, and private lands. Many owl sites on national forest lands are located in highly fragmented areas, especially along the southern portions of the Quinault and Hood Canal Ranger Districts. Habitat within Olympic National Park is found in relatively large, intact drainages broken by high, rocky, and snow-covered mountains. Individual owl pairs along the Olympic National Park coastal strip have become relatively isolated from the remaining spotted owls in the interior peninsula. Effects of habitat loss on spotted owl productivity, dispersal, and turnover on the peninsula are not well known.

Declining Habitat. In the near future, the expected net rate of habitat loss under current management will jeopardize significantly the potential for recovery on nonfederal lands. Habitat has been reduced to critical levels on national forest lands and is declining. Habitat is unchanged and in good condition on suitable portions of national park lands.

Distribution of Habitat and Population. Suitable habitat in the interior peninsula is shaped largely like a doughnut, with the center or "hole" consisting of high-elevation, nonforested areas of unsuitable habitat. Remaining habitat and owls on the Olympic Peninsula are located centrally around this "doughnut hole" within the higher-elevation areas of Olympic National Park and Olympic National Forest. Large areas of recently logged, low-elevation lands are occupied by scattered, relatively isolated pairs of spotted owls in remaining patches of older forest. This central clustering restricts the distribu-

tion of spotted owls to a portion of the province, generally at higher elevations. The long-term stability is unknown for these populations that once inhabited a wide range of ecological conditions, but are limited now to high-elevation habitat.

Predation and Competition. Levels of predation by great horned owls and competition with barred owls and northern goshawks on the Olympic Peninsula are not understood well. Barred owls are present on the peninsula, but no evidence of competition has been documented. Predation by great horned owls may have increased over historic levels with an associated decrease in the survival of northern spotted owls.

Province Isolation. The Olympic Peninsula province is isolated on three sides by coastline; the Pacific Ocean to the west, the Straits of Juan de Fuca to the north, and Hood Canal to the east. To the south, timber harvest in the lowlands of western Washington virtually has eliminated spotted owls. Currently, approximately 60 miles separate owl subpopulations on the Olympic Peninsula and subpopulations in the western Cascades. Distance between currently known reproductive pairs is approximately 75 miles. Isolation may decrease the number of successfully dispersing juveniles and inhibit movement of adults among populations (Thomas et al. 1990).

There is little or no dispersal between this and other populations, and demographic rescue would be unlikely in the event of a population decline on the Olympic Peninsula. Following such a decline, inbreeding could become a concern.

Offsetting a demographic decline on the peninsula or restocking a population areawhere spotted owls have become locally extirpated due to catastrophic or stochastic events would be assisted by demographic connectivity between spotted owls on the Olympic Peninsula and those in other provinces. This likely would require establishment of groups of breeding pairs in the western Washington lowlands province.

Vulnerability to Natural Disturbances. Wind is the dominant disturbance factor along the western coast of the peninsula and as far as 20 to 30 miles inland. Historic stand-replacing wind events occurred in 1921 and 1962 (Appendix F). Logging within the past 30 years has resulted in increased fragmentation on Forest Service, state, and private lands. Exposed forest edges are much more susceptible to wind damage than are relatively unfragmented patches. The potential is high for a large-scale wind event to adversely affect spotted owl habitat in this region (Appendix F). Fire is also a significant threat on the Olympic Peninsula, particularly in the eastern portion. Recent fires, such as the Forks Burn, were stand-replacement events that eliminated significant tracts of spotted owl habitat. Agee (1991b) suggests that under a worst case scenario, wind and fire could reduce the capability of the Olympic peninsula to support spotted owl pairs by up to 30 percent during the next 100 years.

Western Washington Lowlands

Ownership in this province is largely nonfederal and includes major urban, industrial, and agricultural areas. Most forestland is owned by the State of Washington or large industrial timber corporations. This province includes the Puget Trough and southwest Washington physiographic provinces as delineated by Franklin and Dyrness (1973) because these regions show similarities in spotted owl densities, land ownership patterns, and ecological conditions.

Southwest Washington occupies a key position on the landscape. It is the only area where connectivity could be reestablished with the currently isolated population of northern spotted owls on the Olympic Peninsula. Major threats to the few currently known spotted owls in the western Washington lowlands province include low numbers, local isolation, habitat loss, and poor distribution.

Low Populations. There has been considerable concern for spotted owls in this geographic region (Thomas et al. 1990, USDI 1990). Currently three pairs and one territorial single are known in the province. In terms of population stability and structure, spotted owls essentially have been eliminated.

Limited Habitat. Forestlands in the western Washington lowlands were logged early in the settlement of the state, and a considerable area was converted to urban, industrial, and agricultural lands. Historical observations of spotted owls are documented from the early communities of Seattle and Tacoma (WDW 1991). Habitat conversion has been extensive from Tacoma north to the Canadian border, and likely will increase significantly during the next 100 years as human populations increase. Extensive forestlands still remain in the southwest portion of the state. Many of these lands already have been logged twice.

Spotted owl habitat has been reduced greatly during the past 60 to 80 years. Late-successional forest currently remains in relatively small, scattered parcels, seldom more than a few hundred acres in size. The few existing spotted owls are located in these patches surrounded by young forest or are inhabiting younger forest stands that have retained snags and/or dead, decaying logs from previous harvest or natural disturbance.

Declining Habitat. The little suitable habitat remaining within the province likely will be reduced further unless immediate action is taken. Of equal or greater concern is the rate of harvest of mature forest, which may serve as the potential foundation for restoration of owl habitat in the province.

Province Isolation. Spotted owls within the province are extremely isolated from one another, with little opportunity for interchange among territories. The province currently does not provide for demographic interchange with any of the neighboring provinces. Providing for that interchange will require developing subpopulation centers, essentially by growing habitat for a number of pair clusters.

Predation and Competition. Predation by great horned owls may be a threat to the few remaining owls or to development of owl clusters in the future. Recent surveys suggest that great horned owls are numerous (Table 2.5).

Vulnerability to Natural Disturbances. Portions of the province along the Pacific Coast may be susceptible to wind damage, similar to the western portion of the Olympic Peninsula. Wind and fire are potential threats to the few remaining spotted owls in the province.

Western Washington Cascades

The western Washington Cascades province lies west of the Cascade Crest from the Columbia River north to the Canadian border. Ownership is primarily federal, although state, private, and municipal ownerships play important roles for spotted owls in several areas. The province consists of three geographic areas: the northern Cascades (Interstate 90 to the Canadian border), the Interstate 90 (I-90) corridor (north of Mt. Rainier to I-90), and the southern Cascades (Mt. Rainier south to the Columbia River). Significant topographic

differences occur in the northern and southern portions of the province. The northern area is dominated by high mountains and ridges unsuitable for spotted owls and lower valleys with suitable spotted owl habitat. The resulting landscape pattern is a mosaic of alternating valleys of suitable habitat and unsuitable ridges, a naturally fragmented environment for spotted owls. The southern portion is much less dominated by mountainous areas, and spotted owl habitat is more continuous, although still highly fragmented by past timber harvest.

Low Populations. The currently known spotted owl population includes approximately 200 pair and single owl territories (WDW 1991). This number will change as additional areas are surveyed. Spotted owls are found throughout the province, although at lower densities in the northern portion and in the I-90 corridor area. The I-90 corridor is an area of checkerboard ownership lands (federal with state, private, or municipal) that has been harvested heavily in the past 20 to 30 years. Approximately 20 spotted owl territories occur in the I-90 corridor in the western Washington Cascades province. In the northern region, in only 22 territories are known to have produced young successfully since 1986 (WDW 1991). In addition, owls only two territories in the I-90 corridor have produced young successfully since 1986. Reproductive success has been higher in the southern portion of the province.

Limited Habitat. Current spotted owl habitat generally is located at higher elevations, predominantly on national forest lands. Much of the accessible, low-elevation habitat has been logged previously, and current stands that have regenerated after harvest generally are less than 80 years old.

Few blocks of old-growth forest remain on state, private, and municipal lands. Most of the currently known spotted owls on these lands (outside of checkerboard ownership lands) inhabit patchwork mosaics of remnant old-growth stands that survived historic forest fires within larger naturally regenerated second-growth stands. The I-90 corridor has been harvested heavily within the past 20 years, as has the area known as the Mineral Block in the Gifford Pinchot National Forest.

Declining Habitat. Spotted owl habitat in the province has declined significantly in the last 30 years. During this time the proportion of old-growth that was potential spotted owl habitat has decreased from about 60 percent to about 40 percent of the area of the Mt. Baker-Snoqualmie National Forest, with similar decreases from about 40 percent to 30 percent for the Gifford Pinchot National Forest (Henderson 1990). The relatively low proportions of old-growth on the Gifford Pinchot National Forest resulted from the Yacolt Burn of 1902 and the eruption of Mount St. Helens in 1980, as well as logging.

In recent years, habitat decline has been most severe, proportion in the I-90 corridor and the Mineral Block of the Gifford Pinchot National Forest. Habitat surrounding 38 randomly selected spotted owl management areas on the Mt. Baker-Snoqualmie and Gifford Pinchot National Forests was analyzed in 1984 (Allen et al. 1989). The average proportion of suitable habitat within 1.5 and 2.1 miles of the center of these areas varied between 49 and 55 percent of the total area at that time. Analysis of information presented in the 1991 Forest Service Timber Sale Biological Assessment indicates that the average proportion of suitable habitat within 1.8 miles of spotted owl territories was near 40 percent (Hays pers. comm.). The difference between these habitat estimates during the past 7 years is an indication of severe habitat decline in a relatively short period of time. In the near future, the expected net rate of habitat loss without protective measures for the spotted owl will significantly decrease the potential for recovery on both federal and nonfederal lands.

Distribution of Habitat and Populations. There are several concerns about the distribution of habitat and owls in the western Washington Cascades province. In the northern portion, no large clusters of spotted owls currently occur. Much of the habitat in lower elevation areas has been eliminated, and interchange among remaining individuals or small clusters of spotted owls likely is inhibited by nonforested, high-elevation ridges, peaks, and glaciers.

As in the northern portion, no large clusters of spotted owls currently occur in the I-90 corridor. Distribution concerns are primarily with north-to-south interchange of dispersing young and adults. With greatly reduced levels of suitable spotted owl habitat in this region, there is significant isolation of the northern and southern portions of spotted owl populations in the Washington Cascades. North-to-south interchange is further restricted by narrowing of federal ownership in the I-90 corridor area.

In the southern portion of the province, two significant distributional concerns occur. Spotted owl populations in Washington and Oregon are separated naturally by the Columbia River. Historically, spotted owls probably were located along the northern and southern banks of the Columbia River. Logging and urban development in lowland areas of western Washington and Oregon have resulted in a restricted area of interchange, or "bottleneck" between spotted owls in both states. Currently, interchange between spotted owl populations in the two states likely occurs only in a 18- to 20-mile zone in the Columbia Gorge, if at all. Primary ownership on the Washington side of the gorge includes state, private, and federal lands. It is unknown to what degree spotted owls in the two states interact. State and private lands are important in addressing these distributional concerns in the I-90 corridor and the Columbia Gorge.

The northwest portion of the Gifford Pinchot National Forest represents another distributional concern. The Mineral Block is critical to potential genetic and demographic interchange between the Olympic Peninsula province and the western Washington Cascades province. Currently, 10 known spotted owl territories are located in this checkerboard ownership block. Nonfederal lands currently support spotted owls, and are important for long-term development of a stable subpopulation in this area.

Province Isolation. The two provinces that comprise the Washington Cascades are connected by contiguous habitat and owls in only a few high-elevation areas, such as Steven's, Snoqualmie, and White Passes. The extent of demographic interchange over these mountain passes is unknown. The northern portion of the province is virtually at the edge of the species' current range. Spotted owls in southern British Columbia are found in low numbers and densities, and are unlikely to provide demographic support to owls in northern Washington. The degree of province isolation in the Columbia River area is unknown. Spotted owls in the Washington Cascades probably are isolated demographically at present from owl populations on the Olympic Peninsula.

Vulnerability to Natural Disturbances. The eruption of Mount St. Helens eliminated a large forested region containing a number of spotted owls. The blast zone is similar in size to an area that might support a large cluster of 20 or more pairs of spotted owls as described by Thomas et al. (1990). A volcanic eruption of Mt. Baker, Mt. Rainier, Glacier Peak, or Mt. Adams could result in elimination of one or more conservation areas, and local isolation of subpopulation centers.

Eastern Washington Cascades

The eastern Washington Cascades province lies east of the Cascade crest from the Columbia River north to the Canadian border. Ownership is primarily federal and Indian lands, although some state and private lands are located in key areas in the province. Within the province are several important sub-areas for spotted owls. The northern portion includes the Okanogan National Forest, and Entiat and Chelan Ranger Districts of the Wenatchee National Forest. The central area stretches from north of the Wenatchee to Yakima, and includes the rest of the Wenatchee National Forest as well as the checkerboard ownership state and private lands (including the eastern portion of the I-90 corridor) and nonfederal lands adjacent to the national forest. The Yakima Indian Reservation also constitutes a sub-area, located south of the Wenatchee National Forest. The southern portion of the province is located south and west of the Yakima Indian Reservation, including portions of the Gifford Pinchot National Forest and mixed ownerships of state and private lands.

Low Populations. Population estimates for the eastern Washington Cascades province range between 250 and 300 current pairs (WDW 1991). There are approximately 160 known pairs in the region. Survey efforts have varied widely among ownerships, with more intensive surveys historically conducted on the Wenatchee and Okanogan National Forests. State, private, and Indian lands received varying degrees of survey effort until 1991, when more intensive survey efforts were undertaken.

Currently, activity centers for 30 spotted owl territories are located on state or private lands in the eastern Cascades. A number of spotted owls with activity centers located on federal lands also likely uses state and private lands, primarily as a result of checkerboard ownership patterns. Approximately 20 spotted owl territories occur in the northern sub-area. These territories largely affect only federal ownership. Approximately 24 known territories occur on the Yakima Indian Reservation. Estimates of current numbers on the Yakima Indian Reservation range up to 50 pairs (Hansen pers. comm.).

Limited Habitat. In general, habitat in the eastern Washington Cascades is in somewhat better condition than that of the western Cascades in Washington. In the I-90 Corridor, there is approximately 10 to 15 percent more habitat in the eastern Cascades than in the western Cascades. This difference may have significant effects on occupancy rates and reproductive success of spotted owls (Bart and Forsman 1990). As in other provinces, much of the lower elevation habitats have been logged heavily but primarily with partial-harvest techniques.

Most spotted owl habitat in the eastern Washington Cascades is found in the Yakima Indian Reservation and four Ranger Districts in the Wenatchee National Forest: Naches, Cle Elum, Leavenworth, and Lake Wenatchee (including the checkerboard ownership nonfederal lands). Much of the region is dominated by high-elevation mountains and ridge-tops that are not suitable spotted owl habitat. These topographic restrictions shift emphasis for conservation to low-elevation, mixed conifer forests and smaller clusters of spotted owls.

Distribution of Habitat and Populations. Spotted owls and habitat are poorly distributed in the portion of the Okanogan National Forest within the range of the species, the Chelan and Entiat Ranger Districts, nonfederal lands between the Wenatchee National Forest and the Yakima Indian Reservation, and the mixed-ownership southern portion of the province. Recovery measures emphasizing habitat development may be needed in these areas to provide for subpopulation centers throughout the province.

Province Isolation. The eastern Washington Cascades province is isolated somewhat from other spotted owl subpopulations on northern, southern, and western boundaries. The two provinces that comprise the Washington Cascades are connected by contiguous habitat and owls in only a few areas. The northern portion of the province is virtually at the edge of the species' current range and the few spotted owls within this region are isolated from larger groups of owls south of Lake Chelan. Spotted owls in southern British Columbia are found in low numbers and densities, and are unlikely to provide demographic support to owls in northern Washington. The degree of province isolation in the Columbia River area is unknown.

Vulnerability to Natural Disturbances. There is a significant potential for large-scale fire in the eastern Washington Cascades province. There is a low probability that any conservation area created in the eastern Cascades of Washington will avoid stand-replacing wildfire over a significant portion of the landscape during the next century (Appendix I'). As spotted owls in the province currently are clustered in a few key areas, fire poses a severe natural threat to population recovery. Similar to the situation in the western Cascades, volcanic eruptions of Mt. Adams, Mt. Rainier, or Glacier Peak could eliminate one or more conservation areas and increase within-province isolation of subpopulations.

5. Threats by Province within Oregon

Oregon Coast Range

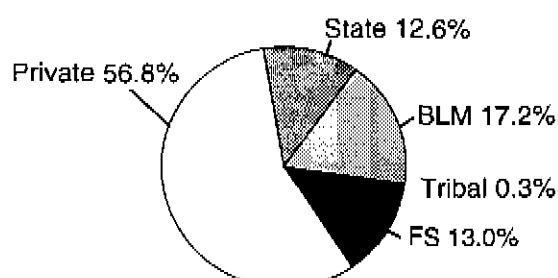
The Oregon Coast Range province lies west of the Willamette Valley and extends along the coast from the Columbia River south to about the Coquille River. The province is characterized by generally low-elevation, productive forests in areas of high precipitation. Land ownership of the approximately 4.48 million acres in the Coast Range is 57 percent private, 13 percent Forest Service, 17 percent BLM, and 13 percent state (Figure 2.4a). Federal lands are represented by the Siuslaw National Forest and parts of the Salem, Eugene, Coos Bay, and Roseburg BLM Districts. Timber harvest and extensive wildfires have greatly reduced and fragmented spotted owl habitat. Threats to the owl population in this province are greater than those in any other Oregon province (Table 2.4).

Low Populations. The owl population within this province is extremely low, particularly in the northern three-fourths of the province. A total of about 325 pairs has been found within the last 5 years. Owls are poorly distributed within the province and exist at very low densities with many pairs isolated by more than 10 miles. Forty-five percent of the known spotted owl sites lie south of Highway 38, in the southern quarter of the province. Most spotted owl sites within the province have less than 40 percent suitable habitat within home range areas (USDI 1991a).

Most owl sites are located in the southern portion of the province and are associated with BLM lands. As a result of timber harvest on the interspersed BLM and private lands, the forest landscape is very fragmented.

The Elliott State Forest is a 93,000-acre block of state-owned land northeast of Coos Bay. Surveys in the Elliott State Forest in 1991 revealed 20 pairs and 18 single owls. These owls are of particular interest due to the age structure of trees within the forest. Sixty percent of the Elliott State Forest is composed of trees from 90 to more than 140 years of age (trees on the remaining area are

Estimated acres of forest landbase:
4,475,000



BLM = U.S. Bureau of Land Management
FS = U.S. Forest Service

Estimated acres of suitable habitat:
743,000

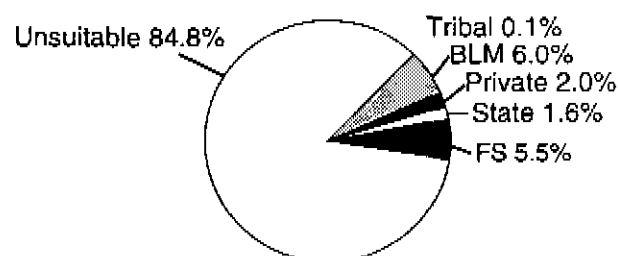


Figure 2.4a. Land base and suitable habitat, Oregon Coast Range.

less than 40 years of age). Research is needed to determine if the population of owls is self-sustaining. Owl populations elsewhere in the province are in significant decline.

Surveys for owls were conducted on 38,000 acres of state land in the central portion of the province (west of Corvallis) during 1990 and 1991. Only 6.1 percent of this state land (6,257 acres) contains trees older than 75 years of age; mean stand size is 26.2 acres (\pm sd 20.2; range 1 to 120 acres). Only one spotted owl response was noted in 1991, with that owl being from a site adjacent to, rather than within, state lands. Although these state lands likely supported owls in previous years, owls no longer exist in this landscape.

The Tillamook State Forest in the northern portion of the province contains 480,000 acres of forestlands, 3 percent of which currently support trees older than 80 years. Large fires in 1933, 1939, and 1945 burned a total of 345,936 acres. Subsequent reforestation has created a relatively homogeneous forest, with stands 30 to 50 years of age. Older forest stands outside of the burned area, now isolated due to timber harvest, contain the remaining owls and habitat. As of September 1991, 25 owl sites were present on state and federal lands north of Highway 18.

Declining Populations. Based on demographic data gathered in the Roseburg study area from 1985 to 1991, the finite rate of increase (λ) for Coast Range study areas is 0.941 (Appendix C), indicating an annual population decline of about 6 percent.

Limited Habitat. Suitable habitat within the Oregon Coast Range is extremely limited and poorly distributed, especially north of Highway 38. Fragmentation of remaining habitat within this province is of significant concern and is due largely to timber harvest and land-ownership patterns. The lack of suitable habitat is particularly acute in the northern part where federal lands are virtually nonexistent. Habitat quantity and quality have been reduced severely due to: 1) extensive timber harvest, 2) fragmentation and isolation of remaining stands, and 3) catastrophic fires and the resulting salvage of live and dead trees. As of August 1991, only 37 percent of the federal lands (Neitro pers. comm., Mellen pers. comm.), 12 percent of the state lands (Johnson pers. comm.), and 3 percent of the private lands (Greber et al. 1990) in the province

were in suitable habitat condition. As of January 1991, suitable habitat existed only on an estimated 15 percent of the forest landbase within the province (all ownerships, Figure 2.4a).

Dispersal and movement within the province is very limited, especially in the northern half, due to the low amount of dispersal habitat on federal and state lands, the general lack of habitat on private lands, and the substantial distances between suitable habitat areas. An assessment of dispersal habitat on federal lands was made using the dispersal habitat criteria of Thomas et al. (1990). For BLM lands, 130 of 264 (49 percent) of the quarter-townships containing one section or more of BLM land did not meet dispersal habitat criteria. For Forest Service lands, nearly all of the quarter-townships containing Siuslaw National Forest lands met the dispersal criteria (Frounfelker pers. comm.). Both of these assessments reflect 1991 habitat conditions.

Declining Habitat. Since 1950, the estimated annual rate of decline in suitable owl habitat for the province has been 2 percent (Figure 2.4b). Throughout much of the Coast Range, remnant stands containing habitat have been reduced to small and often isolated parcels; many of these areas no longer support owls. The little suitable habitat remaining within the province will be further reduced without immediate action. Of equal concern is the rate of harvest of 60- to 80-year-old stands, which may serve as the foundation for restoration of owl habitat in the province.

Distribution of Habitat and Population. The remaining habitat within the province typically occurs as scattered pockets within a matrix of younger

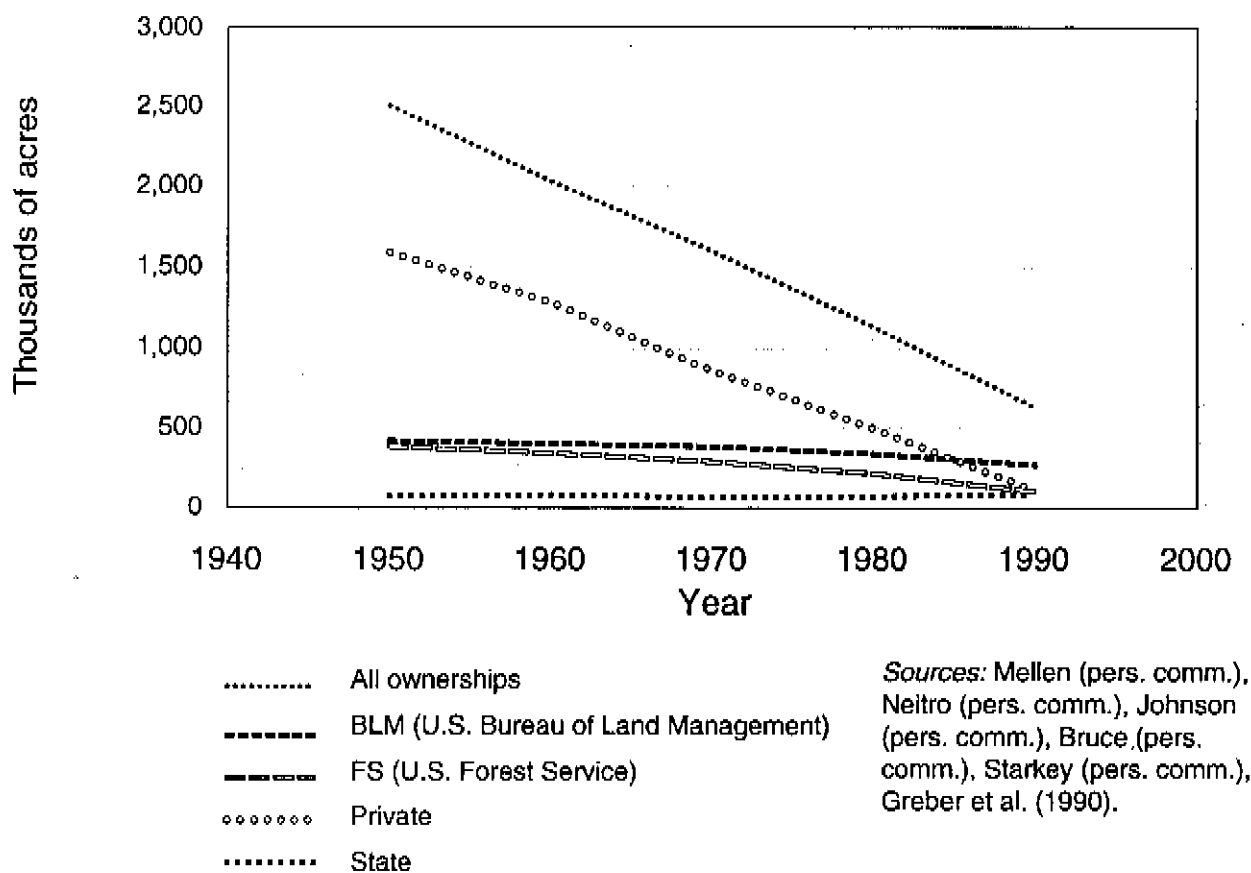


Figure 2.4b. Trend in northern spotted owl habitat, Oregon Coast Range province.

Douglas-fir stands (less than 50 years old). The nearly simultaneous harvesting of large contiguous blocks of industrial-owned lands has created expanses of relatively young forests that isolate the residual suitable habitat and occupied owl sites. Clear-cutting has been the predominant harvest practice within the province.

Few clusters containing more than three pairs of owls exist north of Highway 126. Here, in the northern two-thirds of the province, individual owl sites are generally separated by 3 to more than 15 miles.

Predation and Competition. Great horned owls and northern spotted owls were surveyed in the central Coast Range in 1990 and 1991. Great horned owls were nearly seven times more numerous than spotted owls (Table 2.5). As great horned owls are key predators on spotted owls, this great relative abundance is of concern. Barred owls are distributed throughout the province and have been recorded at 46 sites from 1980 to 1991. The goshawk population is very low in the Coast Range.

Province Isolation. The province is connected to the western Cascades province in Oregon through forested lands south of Eugene, and to the Klamath and western Cascades provinces south of Canyonville. These key linkage areas contain BLM and private lands in a checkerboard pattern. Due to past and present timber harvest on federal and intervening state and private lands, habitat is particularly limited. For example, BLM lands within 50 percent of the quarter-townships in this area do not contain owl habitat adequate for dispersal (i.e., do not meet the "50-11-40 rule" as described in Thomas et al. 1990). Therefore, the risk of isolation of the Oregon Coast Range province is high and will increase with additional harvest of habitat.

Historically, there was probably a significant connection between the Oregon Coast Range province and the western Washington lowlands province, with owls crossing the Columbia River. Timber harvest since 1920 likely has eliminated this connection. To increase the likelihood of owl recovery in these provinces, habitat would have to be developed along both sides of the Columbia River to reestablish the connection between these two provinces.

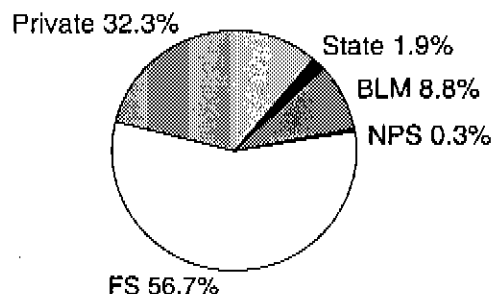
Vulnerability to Natural Disturbance. Extensive fires historically have removed large areas of habitat, although return intervals have been long, and annual risk is fairly low. Because current suitable habitat areas are limited and disconnected, disturbance events could remove key areas.

Western Oregon Cascades

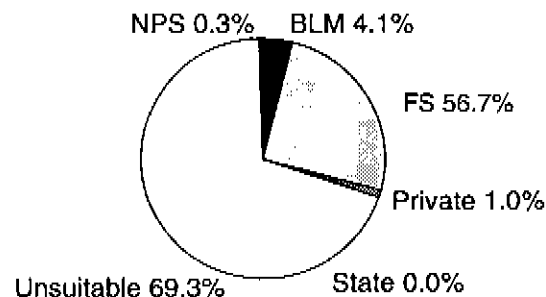
This province lies west of the crest of the Cascade Mountains and extends the length of the state from the Columbia River to the California border. Habitat extends from the eastern edge of the Willamette Valley upslope to about 5,000 feet, and from the moist, true-fir forest in the north to the dry, mixed conifer-pine-oak woodlands in the south. Ownership in this province is 54 percent Forest Service, 34 percent private, 10 percent BLM, and 2 percent state (Figure 2.5a).

Low Populations. Owl populations within this province are moderately high, as is the amount of remaining habitat on federal lands. Areas with low owl numbers occur on 1) private lands, 2) checkerboard BLM lands at lower elevations, 3) checkerboard Forest Service lands in the Santiam Pass area, and 4) higher elevation forests near the Cascade Crest. There are approximately 925 known spotted owl pair sites in this province. Owl use of habitats above 5,000 feet elevation is very limited and few pairs successfully nest above 4,500 feet in this province.

Estimated acres of forest landbase:
4,475,000



Estimated acres of suitable habitat:
743,000



BLM = U.S. Bureau of Land Management

FS = U.S. Forest Service

NPS = National Park Service

Sources: Mellen (pers. comm.), Neitro (pers. comm.), Johnson (pers. comm.), Bruce (pers. comm.), Starkey (pers. comm.), Greber et al. (1990).

Figure 2.5a. Land base and suitable habitat, western Oregon Cascades.

Declining Populations. Based on demographic data gathered from the H.J. Andrews study area from 1987 through 1991, populations in the central portion of the province are declining by about 7 percent annually ($\lambda = 0.928$) (Appendix C). Additional demographic data come from the Medford study area in the southern part of the province. Most of the Medford study area lies within the Klamath province and the remainder is within the western Cascades province. Using data pooled from both provinces within the study area, the annual rate of population decline is 16 percent ($\lambda = 0.844$, Appendix C).

Limited Habitat. Although the western Cascades province has a higher owl density than in any other Oregon province, suitable owl habitat is limited mainly to federal lands (Figure 2.5a). Much of the suitable habitat of federal lands has been fragmented significantly in the past 40 years. For example, within areas approximately equal to the median home ranges of 383 owl-pair sites on the Willamette National Forest, 49 percent of the sites contained less than 40 percent owl habitat, 33 percent contained from 41 to 60 percent habitat, and only 11 percent contained more than 60 percent habitat. No data were available for 7 percent of the pairs (Byford, pers. comm.).

Johnson (pers. comm.) assessed the amount of old-growth and mature forest within 70 plots (totaling 86,695 acres) located at random on Forest Service land within the central portion of the province. The mean amount of old-growth and mature forest within these plots was 53 percent in 1990.

Declining Habitat. Timber harvest from all ownerships for the period 1950 to 1990 indicates an estimated annual rate of habitat loss of 1.4 percent for this province (Figure 2.5b). The rate of habitat loss on federal lands is approximately 1.0 percent annually.

Ripple et al. (1991) assessed the changes in forest fragmentation patterns from 1972 to 1987 on approximately 65,000 acres of national forest land in the

central portion of the province. They reported an 8.7 percent decrease in the amount of natural forest (as a result of timber harvest) and a concomitant 18.0 percent decrease in the amount of interior habitat. The loss of interior habitat, at nearly double the rate of timber harvest, reflected the harvest of timber in a checkerboard manner during the study period.

In a different study, Ripple (pers. comm.) used satellite imagery to assess the changes in the amount of closed-canopy forest and closed-canopy interior forest from 1972 to 1987 on an 866,950-acre study area in the western Cascades province. During this period, the proportion of closed-canopy forest was reduced from 71 percent to 58 percent, along with a significant reduction in closed-canopy interior forest. In this study, closed-canopy forest was defined as stands 30 to 40 years of age or older with more than 60 percent canopy closure, and closed-canopy interior forest was the amount remaining after removal of a 330-foot edge zone.

Distribution of Habitat and Populations. The north-to-south distribution of spotted owls through the central portion of this province is adequate, with the exception of the Santiam Pass area where owl sites are separated by 6 to 10 miles. Owls are scattered on BLM lands along the western portion of the province and some owl sites are isolated by intervening private lands with limited habitat. Few owls are found above 4,500 feet and little suitable habitat exists above 5,000 feet.

The forested lands on the flanks of the western Cascades between the national forest boundaries and the Willamette Valley floor are predominantly privately

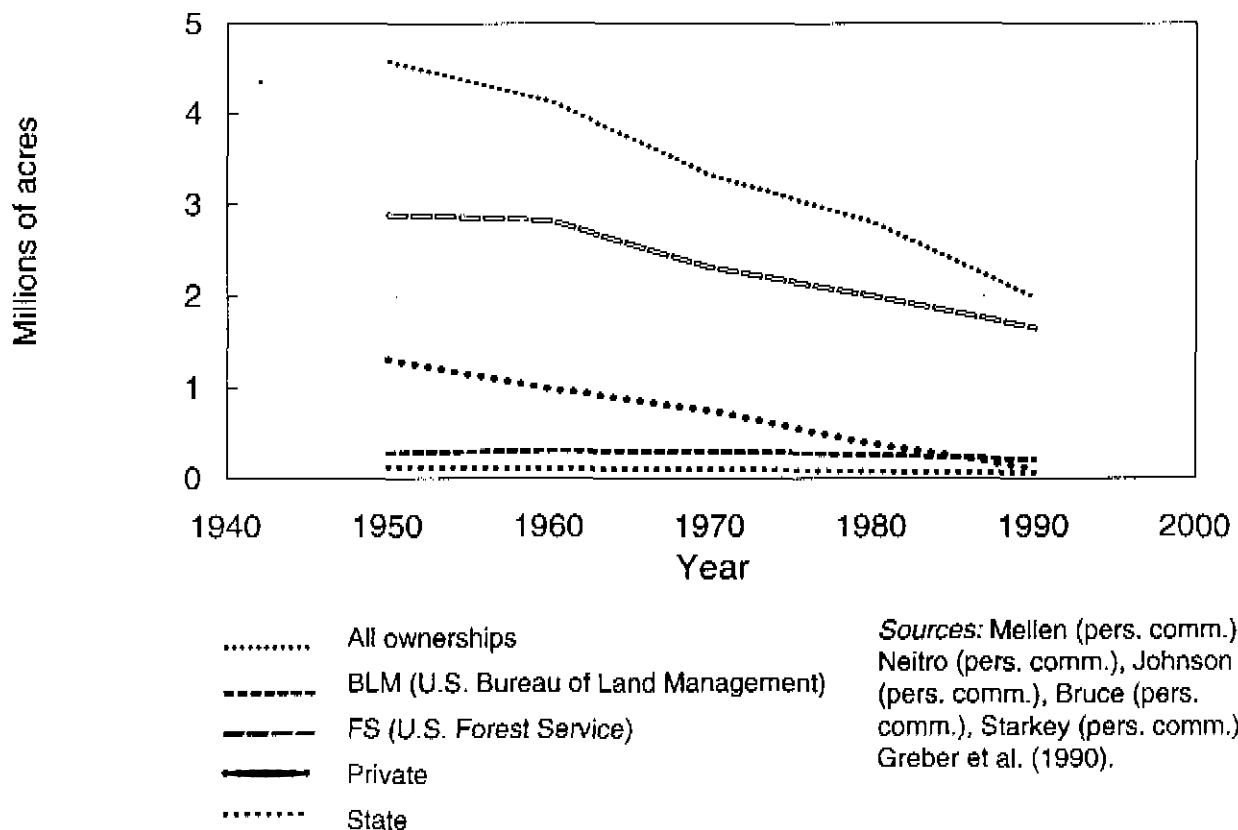


Figure 2.5b. Trend in northern spotted owl habitat, western Oregon Cascades province.

owned and contain little suitable habitat. Although owls are present in low numbers on some of these lands, it is unclear whether the owls are self-supporting or are a result of dispersing owls from nearby source populations.

Predation and Competition. Great horned owls and northern spotted owls were surveyed in the central portion of the province in 1989 and 1990, with great horned owls 60 percent as numerous as spotted owls (Johnson pers. comm., Table 2.5). Barred owls are distributed throughout the province and have been recorded at 156 locations from 1980 through 1991.

Goshawk densities are moderate within this province, and most goshawks are observed within habitats also used by northern spotted owls. Goshawk predation upon adult spotted owls has been observed (Desimone, pers. comm.).

Province Isolation. Prior to development of the Portland metropolitan area and the Willamette Valley, this province would have been connected to the Oregon Coast Range at least along the Willamette River between Wilsonville and the Columbia River. Another possible forested connection may have existed in the vicinity of Salem.

There is concern that the Columbia River Gorge, plus the effects of hydroelectric dams and other recent human activities along the river, have created a barrier to the movement of spotted owls between the Cascade provinces in Washington and Oregon. Spotted owl habitat in this area mainly occurs on the Mt. Hood National Forest in Oregon and Gifford Pinchot National Forest in Washington.

The connection to the Coast Range province is weak, and there is significant concern for demographic instability and isolation of owls in the Coast Range. Habitat that would support east-to-west movements of owls between these provinces most likely can be achieved on BLM lands south of Eugene.

Linkage to the Cascades province in California is threatened by past logging on BLM and private land, and by natural ecological conditions that limit forest development in the area.

The western and eastern Cascades provinces adjoin along the crest of the Cascades Mountains. A barrier to dispersal between these two provinces exists along 40 percent of their common border and consists of high-elevation areas that are 3 miles or more in width, with little or no forest cover.

Vulnerability to Natural Disturbance. Habitat loss due to natural disturbances in this province is caused primarily by fire and wind. Key areas of fire concern for this province are along the Columbia River in the Mt. Hood National Forest (Appendix F), and the area adjacent to the Klamath province in southern Oregon. Although major wind events have occurred in this province (e.g., on Bull Run watershed in 1973 and 1983, Franklin and Forman 1987) most wind events occur on a smaller scale. The effects of most wind events will be to accelerate windthrow along susceptible edges where clear-cuts and roads border protected forest stands. Within DCAs it is expected that, as the younger forest stands develop, and through a program of aggressive fire suppression, the loss of habitat to wind and fire can be effectively reduced.

Eastern Oregon Cascades

The eastern Oregon Cascades province is a narrow band of habitat extending north-to-south along the east side of the Cascade crest from the Columbia River to the California border. Habitat suitable for owls is found in the mixed conifer zone existing between the high-elevation subalpine and mountain-

hemlock forests and the lower elevation lodgepole/ponderosa pine areas. Most of the owls' range in this province is in federal and Indian ownership, although there is some state and private land at the southern end of the province.

Low Populations. The population of owls in this province is very low, primarily due to the inherently low potential for suitable habitat and due to the extent of timber harvest where habitat does exist. Only 163 pairs of owls were found in this province based on 1987 to 1991 surveys, with 89 percent of the owl sites on federal lands. The only area in the province where owl pairs occur in moderate numbers and distribution is within the Mt. Hood National Forest.

Federal lands in this province have been fairly well surveyed for owls, and the Warm Springs Reservation was surveyed in 1991. As a result of these surveys, an estimated 80 to 90 percent of the owl sites are known in the province. Demographic information for owls in this province is limited and no long-term studies have been undertaken.

Major threats to the owl population reflect viability concerns related to the generally poor distribution and low numbers of owl sites, and the inability to provide suitable habitat conditions over the long-term (due to changes in forest-tree species composition and large fires).

Limited Habitat. Because of natural limitations of the landscape it will be difficult to achieve habitat conditions where large clusters of owls (i.e., 20 or more pairs) can be sustained. The alternative is to provide for smaller clusters, relatively near one another, where current or potential habitat exists. Fairly contiguous (although fragmented) habitat conditions exist from the Columbia River south to the Metolius River at the southern end of the Warm Springs Reservation. Current and potential habitat south of the Metolius River generally occurs in blocks less than 4,000 acres in size, isolated from one another by 4 to 25 miles.

Distribution of Habitat and Populations. Most spotted owl habitat in the eastern Oregon Cascades exists on the Mt. Hood and Deschutes National Forests, the Klamath District of the Winema National Forest, and on the Warm Springs Reservation. Based on surveys from 1987 through 1991, 70 owl pairs are known in the Mt. Hood National Forest, 16 pairs in the Warm Springs Reservation, 30 pairs in the Deschutes National Forest, and 37 pairs in the Winema National Forest. Eleven pairs are found on BLM lands west of Klamath Falls, and three pairs in Crater Lake National Park.

With the exception of the Mt. Hood National Forest, habitat and owls are poorly distributed throughout the province. Natural conditions (e.g., soils, moisture conditions), past fire history, and timber harvest have contributed to the isolated nature of habitat and owls in this province.

Predation and Competition. No surveys for great horned owls, goshawks, or barred owls have been undertaken in this province. Incidental observations suggest that great horned owls are numerous, and that goshawks are more common in this province than in the other Oregon provinces. From 1980 through 1991, barred owls have been observed at 27 locations within the province; at 17 sites on the Mt. Hood National Forest, one site on the Warm Springs Reservation, and at nine sites on the Winema National Forest.

Province Isolation. Due to high-elevation subalpine and nonforested conditions along 40 percent of the Cascade crest, the eastern Oregon Cascades province is relatively isolated from the western Cascades province. These conditions pose a barrier for owls in the vicinity of the Three Sisters Mountains, and from Willamette Pass south to about 25 miles south of the southern boundary of Crater Lake National Park.

Vulnerability to Natural Disturbances. The potential for large-scale loss of owl habitat to fire is higher here than it is for any other Oregon province. There is a low probability that any conservation area created in the eastern Cascades of Oregon will avoid a stand-replacing fire over a significant portion of its landscape during the next century (Appendix F).

Klamath (Oregon Portion)

The Klamath province covers large portions of southwestern Oregon and northern California. The Oregon portion lies south of the Coquille River and Roseburg, and west of Medford. Land ownership in the Oregon portion is 35 percent Forest Service, 30 percent BLM, 33 percent private, and 3 percent state (Figure 2.6a). Forest Service ownership includes the Siskiyou and parts of the Rogue and Klamath National Forests. BLM ownership includes much of the Medford District with lesser amounts of the Roseburg and Coos Bay Districts. The Oregon portion of the province is characterized by generally mountainous terrain (e.g., the Siskiyou and Klamath Mountains), a high diversity of forest tree species, often occurring in mixed stands, and large areas of serpentine soils, which generally are incapable of supporting forest conditions. Unforested talus slopes are common. Threats to the owl population include continued loss and fragmentation of habitat from timber harvest, a major threat of habitat loss from fires (see Appendix F), and a declining population.

Low Populations. Numbers and density of spotted owls are moderate in this province, and the population generally is well distributed. Approximately 390 pairs have been found in the province from 1987 through 1991. However, demographic data indicate that the owl population is in significant decline. Poor habitat conditions (due largely to serpentine soils and high elevation) and low owl numbers occur within the Kalmiopsis Wilderness Area. Unlike the California portion of the province, few owl sites are known on private lands.

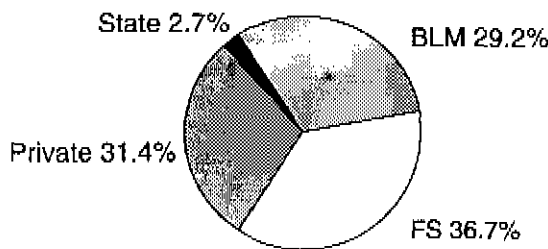
Declining Populations. Based on demographic data gathered from 1985 through 1991 in the Medford study area (Appendix A), owls in this area are experiencing the highest annual rate of decline (16 percent) in Oregon. The nesting success of owl pairs varies annually within all portions of the owl's range, but has been particularly low for this area (and for the Oregon Coast Range as well). In only 3 of the last 7 years has the percent of pairs producing young exceeded 50 percent (of the pairs present), with the highest being 60 percent in 1986 (the lowest was 14 percent in 1987).

Limited Habitat. Approximately 38 percent of the 3,102,000 acres of forested land in this province contains habitat suitable for owls (Figure 2.6a). This habitat is primarily on federal lands and is extensively fragmented, due to timber harvest patterns on the checkerboard and mixed land ownerships, as well as natural vegetation patterns.

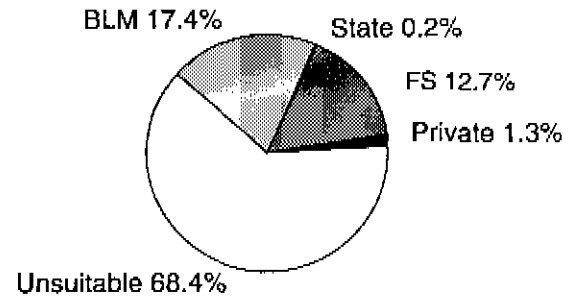
Declining Habitat. The overall estimated rate of habitat decline for all ownerships within the province has been 1.3 percent per year for the period of 1950 through 1990. The rate of decline has accelerated in the last decade to approximately 3 percent annually, primarily reflecting a continued high level of harvest on private land and an increased level of harvest on federal lands (Figure 2.6b).

Distribution of Habitat and Populations. In general, owls and owl habitat are reasonably well distributed within the province. Low owl numbers and/or poor habitat conditions exist in the Kalmiopsis Wilderness Area, on private lands, and within the areas of checkerboard BLM/private lands.

Estimated acres of forest landbase:
4,475,000



Estimated acres of suitable habitat:
743,000



BLM = U.S. Bureau of Land Management

FS = U.S. Forest Service

Sources: Mellen (pers. comm.), Neltro (pers. comm.), Johnson (pers. comm.), Bruce (pers. comm.), Starkey (pers. comm.), Greber et al. (1990).

Figure 2.6a. Land base and suitable habitat, Oregon Klamath province

Predation and Competition. There have been no surveys for great horned owls or goshawks, and their impacts on northern spotted owls are poorly understood in this portion of the Klamath province. From 1980 through 1991, 22 barred owl locations were recorded in this province.

Province Isolation. Due to the fragmented condition of the habitat in the Roseburg and Medford areas, connectivity to the Coast Range and the western Cascades provinces is weak. An assessment of dispersal habitat, as described by Thomas et al. (1990), found that on BLM lands, 140 of 284 (49 percent) of quarter-townships containing one section or more of BLM lands did not contain habitat adequate for dispersal. Of Forest Service lands within the Siskiyou National Forest, 8 of 125 quarter-townships did not contain habitat adequate for dispersal (Webb, pers. comm.). Of particular concern are BLM/private checkerboard lands that are key linkage areas between the Klamath and adjacent provinces.

Vulnerability to Natural Disturbances. The potential for large-scale loss of habitat is high because of the regular occurrence of fire (Appendix F). Due to steep topography and changes in vegetation, fires in this province burn with varying intensities, and create a complex mosaic of burned, partially burned, and unburned areas. Although fires are often large (93,000 acres in the 1987 Silver fire), the total amount of owl habitat actually lost in a fire usually is not great.

6. Threats by Province within California

California Coast

The California Coast province extends south from the Oregon border to San Francisco Bay and from the ocean inland to the western border of national forest lands. The coastal portion of the province encompasses the majority of the redwood forest habitat type. Inland forests are Douglas-fir and mixed

Douglas-fir/hardwood types, the latter often interspersed with chaparral and grasslands. Land is predominantly in industrial and nonindustrial private ownership. Federal lands are represented by scattered small blocks of public land and four National Park Service areas, including Redwood National Park, P.J. Reyes National Seashore, Muir Woods National Monument, and Golden Gate National Recreation Area. State lands include a state forest, and four large and numerous smaller state parks.

Low Populations. Population levels are relatively high, with almost one-third (370) of the known activity centers for northern spotted owls in California found in this province. About 155 sites have had verified pairs from 1986 through 1990. There is an average of 2.3 known owl sites per township expected to contain suitable owl habitat.

Declining Populations. Spotted owls generally are widespread in the province, having been found in 56 percent of the townships in the province, or in 71 percent of the townships where suitable habitat exists and thus where they would be expected to occur. One known or no owl sites have been found in 50 percent of the townships where the owl would be expected to occur. More than nine sites each are known from three townships, indicating that some habitat conditions can support high densities. One township on heavily harvested, commercial redwood forestland supports at least 18 sites.

Demographic information indicates that owls in this area are occupying sites and reproducing at rates similar to owls in other areas. Survival information is limited so estimates of population stability are not possible.

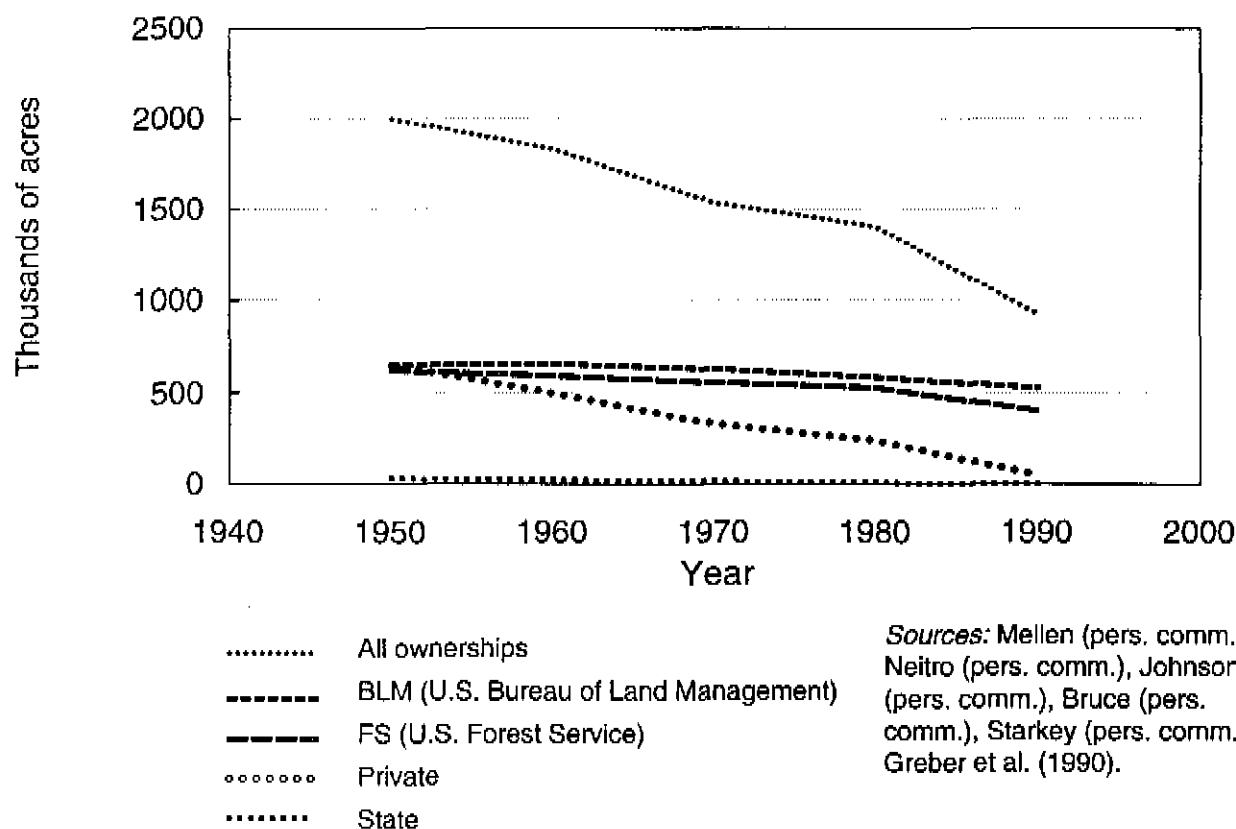


Figure 2.6b. Trend in northern spotted owl habitat, Klamath province (Oregon portion).

Limited Habitat. Spotted owl habitat is expected to occur in about 79 percent of the townships in the province. There are slightly more than 2 million acres of forestlands in this province where timber production is the main management goal.

There is a long history of habitat alteration in coastal redwood forests. There are approximately 1.95 million acres of redwood forestland, of which a very large portion (probably more than 75 percent) was historically in an old-growth condition. There are approximately 85,000 acres of old-growth redwood forest remaining today, 21,000 acres of which are in private ownership. The vast majority of known owls is in well-developed second-growth, usually older than 50 years. There are approximately 740,000 acres of larger second-growth redwood forest in the province. Most of this forest is commercially available and is being harvested by a variety of methods reflecting the management philosophies of landowners. The currently suitable owl habitat in the redwood timber type appears to be high quality, and most neighboring pairs are not widely separated.

Douglas-fir and Douglas-fir/hardwood forests predominate in the timbered land inland from the redwood belt. This area occupies roughly a quarter of the province with the remaining portion being brush and oak/brush lands. These generally unsuitable lands for owls are interspersed with, and in some areas naturally fragment, the more suitable Douglas-fir and Douglas-fir/hardwood forests. There are no commercially available old-growth Douglas-fir or Douglas-fir/hardwood forests in the province, but harvest occurs in the second-growth Douglas-fir types.

Declining Habitat. Redwoods are limited geographically to the coastal portion of this province. The wood is in relatively high demand, and available old-growth is rare. Harvest on private lands in the north coast accelerated during the 1980s. From 1986 through 1989, the average annual acreage cut in this area was 102,029 acres. Approximately 83,000 of those acres, or about 4 percent of the timber producing lands, were treated annually with stand-replacement harvests. Protected second-growth habitat within Redwood National Park will provide additional habitat as these stands mature.

Distribution of Habitat and Populations. Owls and owl habitat generally are abundant and widespread across the northern and western portions of the province where redwood and coastal Douglas-fir habitats predominate. Owl densities average 3.6 known owl sites per township where suitable owl habitat is expected to occur.

In some areas of the province, owl habitat is distributed naturally in an irregular pattern. A north-to-south band from southeastern Humboldt County to central Mendocino County contains a natural mix of Douglas-fir forest in canyons, hardwood forest on slopes, and grasslands on ridges. This area is relatively unsurveyed, but the distribution of owls and their habitat is not continuous. Similar conditions, without the Douglas-fir forests, continue south through Lake County. One-third of the townships in this area is not expected to contain suitable owl habitat. On average, one known owl site occurs in those townships that are expected to contain suitable habitat.

Owl populations in Marin County, and Napa and Sonoma Counties (21 and 27 sites respectively) are isolated. Naturally occurring grasslands and hardwood/brush areas separate these owl populations from the continuous range of the subspecies that occurs to the north and northwest. The Napa and Sonoma County owls are 16 to 20 miles from the main body of the population in western Sonoma County and 32 miles from owls in the southern part of the Klamath province in Lake County. The Marin County population is at least 17

miles from the contiguous population of owls in the province to the north and 27 to 31 miles from the other isolated population in Napa and Sonoma Counties to the east.

Owl habitat in the province is found on a greater variety of ownerships than in any other province of the state. Private industrial land ownerships comprise the largest single group. The multiplicity of ownerships in Marin, Napa, and Sonoma Counties, along with early logging history, agricultural, and residential land developments have resulted in extensive habitat fragmentation. Coordination and cooperation will be necessary in achieving recovery in this province.

Province Isolation. Owl habitat is contiguous along the northern two-thirds of the 220-mile boundary between the California Coast and California Klamath provinces. In the southern one-third, suitable habitat in both provinces is naturally fragmented, and owl sites are at lower densities. The southern end of the province is isolated from other provinces, although the range of the California spotted owl extends to within 110 miles to the south (across San Francisco) and 90 miles to the east (across the Sacramento Valley).

Predation and Competition. Great horned owls, red-tailed hawks, and ravens occur naturally throughout the province. Natural grasslands are interspersed throughout the province and their occurrence indicates a history of contact between grassland and forest species. However, current logging is opening second-growth stands, and when forests are limited this harvest decreases the area available as refuge from avian predators.

Barred owls were first identified in the province in 1981. Seven of the nine known barred owl sites have been found in the last 3 years. Currently, competition from barred owls in the province appears to be low, but barred owls occupy at least one site previously occupied by northern spotted owls, and a hybrid is known to have paired with a northern spotted owl (Gould pers. comm.).

Vulnerability to Natural Disturbance. Fire probably is the major, short-term disturbance event that would affect forests in the province (Appendix F). Much of the coastal area supports moist redwood and Douglas-fir forests that do burn. However, fires are generally smaller and less frequent than those in provinces farther inland. In the mixed Douglas-fir/hardwood/grassland zone on the eastern side of the province, fire is a considerably more frequent event. Wind damage, and insect and drought problems also appear to be relatively minor in the province.

Klamath (California Portion)

The California Klamath province is located between the California Coast province and the California Cascades province. It is a continuation of the Oregon Klamath province south to the Clear Lake Basin in the Inner Coast Range. The area is mountainous and covered primarily with Douglas-fir forests. Mixed Douglas-fir forests are common at lower elevations with Douglas-fir/true fir forest at higher elevations. The province primarily consists of four national forests and includes four major wilderness areas. There are a few parcels of other public lands and some private forestlands. The private and public lands mostly occur near the eastern edge of the province.

Low Populations. Owl populations are moderate in this province, which contains 750 sites. There have been about 455 pairs verified from 1986 through 1990. Suitable habitat contains an average density of 3.7 known owl sites per township.

Declining Populations. Spotted owls generally are widespread in the province, having been found in 85 percent of the townships in the province and in 95 percent of the townships where suitable owl habitat would be expected to exist. One or no owl sites have been found in 23 percent of the townships where the owl is expected to occur. More than nine sites each have been found in seven townships, and one township has 20 known sites. Populations in the Willow Creek study area have been decreasing by nearly 9 percent annually during the last several years (Appendix C). In some areas known sites have disappeared due to habitat modifications.

Limited Habitat. There are an estimated 1,070,000 acres of suitable owl habitat in Forest Service lands in northern California, of which 80 percent is estimated to be in the Klamath province. Additional habitat is found on private lands which generally occur along the eastern edge of the province.

Habitat generally is not highly fragmented and individual pairs normally are not isolated or becoming isolated in the western and central parts of the province. Along the eastern edge, there are areas of poorer soils, intrusions of higher-elevation areas and drier conditions, all of which result in lower amounts of suitable owl habitat. Natural fragmentation and the isolation of individual pairs (such that sites are more than 6 miles apart) occur at the southern end of the species' range in this province. Forest is limited or absent in this area due to lower and drier conditions.

Declining Habitat. There has been significant loss of habitat to clear-cutting on national forest lands, most of which has occurred since the mid-1940s. A reduction of 40 percent (212,000 acres to 126,200 acres) in the area of mature and old-growth, closed-canopy forest has occurred on the Six Rivers National Forest. This occurred with an average annual harvest (1960 to 1984) of 158.6 million board feet. Other national forests probably are undergoing a decrease in available habitat with average annual cuts of 80.2 million board feet (prior to 1984) on the Mendocino National Forest and 248.0 million board feet (1974 to 84) on the Shasta-Trinity National Forest.

Much of the lower elevation, mixed conifer forest on private lands along the northeast edge of this province was cut heavily earlier in the century. The resultant second-growth now is being cut, primarily using uneven-age management techniques. This has resulted in less absolute loss of suitable habitat than clear-cutting would have, but the level of successive partial cuts that might cause degradation of owl habitat is not known. From 1986 through 1990, the average area harvested on private lands in Glenn, Shasta, Siskiyou, Tehama, and Trinity Counties (some areas also in the Cascades province) was 103,000 acres per year. An average of 41,000 acres was in stand-replacement harvest prescriptions.

Distribution of Habitat and Populations. Owls and owl habitat are present within 92 percent of the townships in the province, and are found across the full range of ecological conditions that provide suitable owl habitat within the province. Owls and owl habitat generally are well distributed throughout the western and most of the central portion of the province.

The eastern and southern parts of the province are drier, the forest is more fragmented, and owl densities are lower than in the western and central part of the province. The northeastern section also contains a large, lower-elevation valley with unsuitable owl habitat. A third of the townships in the eastern section are not expected to have owls, or have owls at low densities. Spotted owls have been found in 94 percent of the townships that would be expected to have owls because of the presence of suitable habitat.

In comparison, the southern part of the province is typified by dry, brush-covered, south-facing slopes and forested, north-facing slopes. Owls occur in 96 percent of the townships in the southern part. Only 4 percent of the townships have more than four owl sites each, while 24 percent and 42 percent of the townships in the eastern and north/central parts of the province, respectively, have more than four known sites per township.

Province Isolation. This province is located between the other two California provinces and is continuous with the Oregon Klamath province. Owls and habitat occur along the borders with the three other provinces except where areas of natural habitat fragmentation occur along the southwest and north-east boundaries. The Klamath province is contiguous with the California Coast province for the first 115 miles south from the Oregon border. It is probably contiguous with the same province for another 105 miles but the habitat in the adjoining California Coast province supports mostly dispersal habitat and little breeding/roosting habitat.

The Klamath province is contiguous with the California Cascades for about 110 miles. However, suitable owl habitat only occurs along the mutual border between the two provinces for the 55 miles south of Shasta Valley. Habitat here is not contiguous and is found as pockets of suitable habitat among areas of higher elevations, unsuitable soils, or past timber harvest. South of Redding, the remainder of the eastern border of this province directly abuts California's Central Valley, which is not suitable habitat. Suitable habitat in the range of the California spotted owl is 35 to 80 miles to the east in the Sierra Nevada.

Predation and Competition. Great horned owls occur naturally throughout the province. Predation on spotted owls by great horned owls has been noted in field studies in the province. Additional studies will be required to determine whether great horned owl numbers are increasing.

Barred owls have been identified in the Klamath province during the last 8 years. This number has grown dramatically in the last 3 years from 4 to 15 known sites. Pairs of barred owls were found at one-third of these sites in the last 2 years. The potential for competition may be increasing rapidly, but the effects on local spotted owls are not known.

Vulnerability to Natural Disturbance. Fire is the major disturbance event likely in the Klamath province. This area has a history of many natural fires. However, fire suppression during the last 70 to 100 years has resulted in increased accumulation of fuels and has made large and hot fires more likely than was true historically. This has led to a recent history of large fires (e.g., Hog fire on Klamath National Forest; 1987 fires on Klamath, Shasta-Trinity and Mendocino National Forests).

Wind damage is a relatively small problem compared to other parts of the Pacific coast. Drought and drought-caused insect and disease problems are of concern, especially in some of the drier areas.

California Cascades

The California Cascades province is located in the north central portion of the state, between the Oregon Cascades provinces, the Klamath province, and the range of the California spotted owl at the north end of the Sierra Nevada. Suitable owl habitat generally is fragmented on a broad scale by the Shasta Valley, Mt. Shasta, and other high-elevation areas of unsuitable soils, and areas of marginal, low-elevation habitats. Suitable forest habitat is mostly on national forests, although there are significant blocks and checkerboard areas where forests occur on mostly industrial private lands.

Low Populations. Population levels are low in this province. There are only 71 known sites, or only about 6 percent of the known sites in California. Pairs have been verified at about 35 sites from 1986 through 1990. The density of sites found since 1970 is only 1.0 per township.

Declining Populations. Owls and owl habitat are present across a range of ecological conditions within the province, but habitat is fragmented. Owls are known from only 40 percent of the townships in the province and from 51 percent of the townships where possibly suitable habitat exists. Even though the area is fairly well surveyed, 48 percent of the townships with owls have only one known owl site, and only 5 percent have more than four owl sites each. Even where owls occur, population densities are low in the province.

Demographic information for owls in the study area is scarce. There is no demographic information from field studies. The only available information is limited to survey and inventory work with anecdotal observations of reproduction, Forest Service monitoring sites, and private lands surveys which have been conducted only in the last 2 years.

Limited Habitat. The California Cascades province is small, containing only about 110 townships. Twenty-three of these townships probably do not contain suitable owl habitat and another 43 contain only marginal habitat. Habitat is mainly found on parts of the Klamath and Shasta-Trinity National Forests and interspersed private lands. There are about 500,000 acres of land suitable for timber harvest on the Shasta portion of the Shasta-Trinity National Forest. About 220,000 of these acres are in stands with crown diameters greater than 13 feet and canopy closure greater than 40 percent. However, much of this area does not meet the Interagency Scientific Committee's (ISC) "50-11-40" standard for dispersal habitat (Thomas et al. 1990).

Declining Habitat. Timber harvesting often extends over large areas, but commonly does not involve clear-cutting. Habitat loss in this area is difficult to estimate because of the patchy distribution of habitat chosen by the owls, perhaps the result of previous tree cutting and/or thinning and the possibly low historical levels of suitable habitat due to fire history.

Distribution of Habitat and Populations. Habitat is fragmented throughout the province. Landscape-scale fragmentation is demonstrated by the division of the 44 townships where owls are found in six separate clusters. Suitable habitat is fragmented on a local level and individual owl sites are often widely separated from nearest neighbors. This fragmentation and the isolation of individual sites may be natural in part and partially the result of timber harvest. There is only one area where the ISC found a block of contiguous habitat sufficiently large to form a habitat conservation area that would support 16 sites.

The eight sites north of Gooseneck Mountain in the Klamath National Forest and private lands are the only isolated population in the province. Natural barriers (Shasta Valley, Klamath River Canyon, and a high-elevation pass) separate this area from the remainder of the province and from other adjacent provinces.

Province Isolation. The California Cascades province is bordered on the west and north by the California and Oregon Klamath provinces, the western Oregon Cascades and the eastern Oregon Cascades provinces. It abuts the range of the California spotted owl to the southeast. Although the province is bounded by others on three sides, it is somewhat isolated from those provinces. The Shasta Valley separates the northern California Klamath province from the Gooseneck section of the California Cascades by 20 miles. The

Sacramento River Canyon now provides a 10- to 13-mile division between known owl sites in the California Klamath and Cascades provinces. A narrow band (about 20 miles wide) of low-density owl habitat provides an obstacle to owl movement between the California Cascades and the northern Sierra Nevada. While there are forests in some of these gaps, habitat quality and owl densities in these areas are low. These conditions may be sufficient to ensure genetic connection, but probably limit the amount of demographic support that could be provided by adjacent provinces.

Predation and Competition. Great horned owls naturally occur throughout the province because of the open forest condition and the history (more than 50 years) of large-scale habitat modifications in the province. Fire suppression probably has resulted in the exclusion of great horned owls from some forest habitats that are now denser than they were historically.

Barred owls were first identified at two sites in the province in 1991. The current competition from barred owls is probably low, but is potentially detrimental, especially for this sparse and high-risk spotted owl population.

Vulnerability to Natural Disturbance. Fire is the major natural disturbance likely in the California Cascades province. Fire may not be as great a problem as in the Klamath province, because of the presence of areas of naturally poor soils and sparser vegetation. However, fire probably affected the composition and structure of the historic forest. Fire suppression during the last 70 to 100 years probably has increased vulnerability of the forest to wildfires. Wind damage is a minor problem, but drought and insect/disease problems are of concern.

II.

C. Current Management

Habitat of the northern spotted owl is managed by many individuals, corporations, federal and nonfederal agencies, and Indian tribes. The large number of entities involved and the diversity of statutory and regulatory authorities under which land is managed pose a challenge and provide opportunities for coordinating landscape-level conservation measures for the species. The following sections explain federal, state, and Indian land management authorities throughout the range of the northern spotted owl. The sections are organized to accommodate the specific roles played by the groups that will participate in recovery. In each case, the intention is to show the means available to participants carrying out the recovery plan.

1. Forest Service

Management Background

Prior to the early 1970s, little was known about the northern spotted owl in national forests in Washington, Oregon, and California except that it resided in a variety of forest types. Early research in Oregon and California indicated an association with mature and old-growth forests.

In 1973, an interagency committee was organized, consisting of biologists from the Forest Service, BLM, FWS, Oregon Department of Fish and Wildlife, and Oregon State University. The committee, known as the Oregon Endangered Species Task Force, recommended that 300 acres of old-growth forest be retained around every known spotted owl nest site.

During the next 3 years, research provided information about spotted owl habitat needs (Gould 1974; Forsman 1976). In November 1976, the regional forester for the Pacific Northwest Region directed that nesting sites of spotted owls be protected on national forests in Oregon, as prescribed by the task force, until biological unit management plans were developed.

In 1976, the Oregon Endangered Species Task Force recommended a long-range goal to maintain 400 pairs of spotted owls on public lands in Oregon. The task force spent 1977 developing objectives and management prescriptions to meet that goal. For that 1-year period, the task force recommended that involved agencies protect locations around northern spotted owl nests and areas where spotted owls had been sighted.

On November 3, 1977, the Oregon Endangered Species Task Force released its Interagency Spotted Owl Management Plan. In the plan, national forests in Oregon were requested to support at least 290 pairs of spotted owls, the BLM was asked to support 90 pairs of spotted owls, and 20 pairs were identified for lands in other ownerships. Each pair of spotted owls was to be provided with a minimum of 1,200 contiguous acres of habitat consisting of a core area of at least 300 acres of old-growth conifer forest (to the extent it was available) and an additional 900 acres, of which at least 50 percent was to be in stands more than 30 years old. Additional criteria were given for the distribution of habitat and proximity among pairs of spotted owls.

On January 11, 1980, there was an appeal of the decision not to prepare an environmental assessment or an environmental impact statement prior to adoption of the Oregon Endangered Species Task Force's Spotted Owl Management Plan. The Chief, U.S. Forest Service, Washington, D.C., upheld the decision by the regional forester for the Pacific Northwest Region. However, the Chief directed that the Regional Guide for the Pacific Northwest Region, and accompanying environmental impact statement include (1) a biological analysis to determine the number and distribution of spotted owls that would constitute a viable population, (2) regional management and monitoring standards, and (3) an evaluation of needed research. The Forest Service also directed that until the regional plan was approved, 290 pairs of spotted owls should be protected on national forests in Oregon using the guidelines in the Interagency Spotted Owl Management Plan. Where necessary, adjustments were to be made to timber sales offered after October 1, 1980.

In October 1980, national forests in Washington were directed to protect, in accordance with the Interagency Spotted Owl Management Plan, the habitat of all confirmed spotted owl pairs. In April 1981, tentative allocations of spotted owls were assigned for the Gifford Pinchot, Mt. Baker-Snoqualmie, Olympic, and Wenatchee National Forests. These allocations totaled 112 pairs of spotted owls.

Also in 1980, the Spotted Owl Subcommittee, which replaced the task force, revised its Spotted Owl Management Guidelines in light of additional research and information. Results of radio-telemetry studies of spotted owls (Forsman 1980) became available in December 1980. These studies indicated that the amount of suitable habitat that existed within 14 home ranges studied was much greater than 300 acres. The Spotted Owl Subcommittee also worked with other consultants during 1980. Dr. Michael Soulé recommended protection of a population of 500 or more pairs for genetic reasons.

Based on the report from Forsman (1980) and consultation with Soulé, the Oregon-Washington Interagency Wildlife Committee revised the Interagency Spotted Owl Management Plan in February 1981. The revision called for 1,000 acres of old-growth habitat to be maintained for each spotted owl pair, with 300 acres around the nest site, if known, and an additional 700 acres within 1.5 miles of the nest site.

In May 1981, the Forest Service issued the Draft Pacific Northwest Regional Plan. The plan contained direction on the number and distribution of spotted owl pairs to be evaluated in forest planning. It also included in the appendix the February 1981 revision of the Oregon Interagency Spotted Owl Management Plan.

In 1982, the Forest Service, in cooperation with the BLM, initiated an Old-Growth Wildlife Research and Development Program in the Forest Service's Pacific Northwest Research Station.

During 1984, more information about spotted owls was published by Forsman et al. (1984). In May of 1984, the Regional Guide for the Pacific Northwest Region and accompanying final environmental impact statement were published. These documents replaced the draft environmental impact statement for the regional plan. The regional guide included standards and guidelines for forest-level planning of spotted owl habitat management, and directed national forests to analyze the effects of protecting at least 375 pairs of spotted owls in Oregon and Washington national forests.

Interim direction in the regional guide specified that until forest plans were approved, national forests were to manage for the tentative regional total of 402 pairs, with each pair being allocated 300 acres of old-growth habitat.

In April 1984, national forests in Oregon and Washington were directed to locate habitat areas to maintain a well-distributed population of spotted owls. Establishment of habitat areas subsequently was considered necessary and sufficient to meet the management requirement for population viability.

On October 22, 1984, the National Wildlife Federation, Oregon Wildlife Federation, Lane County Audubon Society, and Oregon Natural Resources Council filed an administrative appeal to the standards and guidelines for management of northern spotted owl habitat contained in the regional guide. The regional guide was remanded to the Forest Service with direction to prepare a supplemental environmental impact statement.

In California, several national forests had not yet begun by 1984 to implement the regional standards and guidelines because of delays in preparing individual forest management plans. The California Department of Fish and Game and the Forest Service agreed that regional standards and guidelines should be implemented before existing owl management options were lost. As a result, a network of spotted owl habitat areas was established on all western Sierra Nevada and northwestern California national forests.

In January 1987, the Forest Service's Pacific Northwest and Pacific Southwest Regions and Research Stations initiated the Northern Spotted Owl Research, Development, and Application Program. This program was designed to accelerate and coordinate all Forest Service activities concerned with owl habitat and population inventory, monitoring, and research. Results of the program have been used by the Forest Service to amend and revise direction for owl habitat management.

In December 1988, the Chief of the Forest Service approved an amendment to the regional guide for the national forests in Oregon and Washington. This amendment adopted standards and guidelines for management of spotted owl habitat in Washington and Oregon, initiated an accelerated research project on the owl's habitat requirements, and committed the Forest Service to revisit the decision in 5 years or sooner should new information become available.

On February 8, 1989, a complaint was filed in the federal District Court in Seattle by the Seattle Audubon Society and other environmental organizations, alleging that the Forest Service's adoption of the amendment to the Regional Guide for the Pacific Northwest violated the National Forest Management Act (NFMA), the National Environmental Policy Act (NEPA), and the Migratory Bird Treaty Act (MBTA). The plaintiffs requested a preliminary injunction on all timber sales containing 40 or more acres of spotted owl habitat on the 13 national forests with owls in Washington and Oregon. In March 1989, the court enjoined 163 timber sales pending further hearings.

Section 318 of the 1990 Interior and Related Agencies Appropriation Act addressed the issue of the spotted owl; the Seattle Audubon Society lawsuit in particular. The act provided additional protection for old-growth forests and existing designated areas managed for spotted owls.

The 1990 appropriation act directed the Chief of the Forest Service to revise his December 1988 decision. Further, the act directed him to consider the conservation strategy being developed by the ISC in the revised decision. "A Conser-

vation Strategy for the Northern Spotted Owl, Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl," was released in April 1990 (ISC).

On September 28, 1990, the Department of Agriculture gave notice that the Forest Service was vacating the December 1988 Record of Decision regarding spotted owl management and that it would manage, "... not inconsistent with the ISC Report."

On October 22, 1990, the Seattle Audubon Society filed an amended complaint with the federal District Court in Seattle alleging that the September 3, 1990, notice vacating the 1988 Record of Decision and the spotted owl habitat area system were illegal. Twelve timber sales were challenged under NFMA, NEPA, and MBTA aspects of the case, and were enjoined in December 1990.

The court ruled on March 7, 1991, that listing of a species under the Endangered Species Act did not relieve the Forest Service of its duty to ensure a viable population of the species. The court also held that the October 3, 1990, notice was adopted in violation of NFMA regulations. Eventually, the Forest Service was enjoined from auctioning or awarding any timber sales in suitable owl habitat while the agency prepared an environmental impact statement and otherwise complied with the court's orders.

The Forest Service filed a notice of intent to issue an environmental impact statement on May 8, 1991, and invited public comment for 3 months. The draft environmental impact statement was issued in September 1991. A final environmental impact statement was completed and the record of decision was signed on March 3, 1992.

Applicable Law

National Forest Management Act. This is the principal law governing management of the national forest system. It requires that national forests develop land and resource management plans. These plans must be updated every 10 to 15 years. The act requires that the plans include but not be limited to the following:

1. An analysis of present and anticipated uses, demand for, and supply of the renewable resources, with consideration of the international resource situation, and an emphasis on pertinent supply and demand and price relationship trends.
2. An inventory, based on information developed by the Forest Service and other federal agencies, of present and potential renewable resources, and an evaluation of opportunities for improving their yield of tangible and intangible goods and services, together with estimates of investment costs and direct and indirect returns to the federal government.
3. A description of Forest Service programs and responsibilities in research, cooperative programs and management of the national forest system, their interrelationships, and the relationship of these programs and responsibilities to public and private activities.
4. A discussion of important policy considerations, laws, regulations, and other factors expected to influence and affect significantly the use, ownership, and management of forest, range, and other associated lands.

Table 2.6. Estimated acres of spotted owl habitat on BLM lands in Oregon, California, and Washington.

State and District	Nesting Habitat	Roosting and Foraging	Total Habitat (Acres)	Total Forest (Acres)
Oregon				
Salem	53,300	120,335	173,665	372,799
Eugene	64,381	55,983	20,364	302,125
Roseburg	117,456	94,724	212,180	395,327
Coos Bay	99,912	23,284	123,196	308,888
Medford	168,715	233,352	402,067	835,189
California				
Ukiah	25,000	^a	25,000	184,640
Washington				
Spokane ^b	600	1,500	2,100	3,000

^aNot yet surveyed

^bHedges (pers. comm.)

2. Bureau of Land Management

Within the geographic range of the northern spotted owl, the Bureau of Land Management (BLM) administers 2.4 million acres in Oregon, Washington, and California. These lands include public as well as railroad grant lands that reverted to federal ownership pursuant to the Oregon and California Sustained Yield Act (O&C Act). The reverted grant lands comprise alternate sections in a checkerboard arrangement in the Medford, Eugene, Coos Bay, Salem, and Roseburg districts in western Oregon. The BLM Oregon office manages the greatest amount of owl habitat, followed by the California and Washington offices, respectively (Table 2.6).

Management Background

The first BLM northern spotted owl habitat management initiative consisted of 79 areas identified for management as spotted owl habitat in an agreement with the State of Oregon as components of the individual district office timber management plans completed in 1983. Each agreement site comprised 300 acres of contiguous old-growth or the next older forest surrounded by an additional 900 acres managed to maintain at least 50 percent in stands older than 30 years. The approach to protection and management of the sites varied by district, but generally harvest from commercial forestland within agreement sites was prohibited and other resource management allocations within sites carried harvest prohibitions as well. Later, in 1983, the BLM and Oregon Department of Fish and Wildlife (ODFW) agreed to establish 11 additional areas for spotted owl protection. The agreement was to remain in effect for 5 years, but was revised in 1987 to extend the expiration date until the planning process for the 1990s is completed in 1992, and to add 20 more agreement sites. This action constrained timber harvest on 230,400 acres around 110 owl locations throughout the five western Oregon BLM districts. The goal was to maintain a well-distributed population of 90 pairs of owls on land administered by the BLM. The actual number of sites was reduced to 109 with the

transfer of one area to the Grand Ronde Indian Reservation through congressional action. This reduced the total area protected to 228,000 acres, and no replacement area was designated.

In 1989, an additional 12 agreement sites were established under instructions to the BLM in section 318 of the Fiscal Year 1990 Interior and Related Agencies Appropriation Act (Public Law 101-121). This brought the total of owl management areas to 121, on which the BLM is deferring harvest on commercial forest stands. The guidance for establishment of these 121 areas was based on work by Forsman and Meslow (pp. 58, 59 in Gutiérrez and Carey 1985). They recommended 2,200 acres of forest more than 80 years old be designated for each site within a 3-mile radius of a known activity center of a single owl or pair of owls. Actual delineation of sites resulted in the acreage varying from 734 to 4,188 acres because of the range size of specific sites determined from radio-telemetry and lack of coniferous stands more than 80 years old.

Based on data collected between 1985 and 1990, the above management provided protection for approximately 20 percent of the known pairs of spotted owls on BLM lands. This plan was designed to provide for long-term maintenance of one pair in each site; however, it was concluded that additional pairs or singles may live within the boundaries of the designated sites.

In May 1990, the ISC released its report on a conservation strategy for the northern spotted owl. In September 1990, the BLM adopted the Jamison strategy, (named for the BLM's Director, Cy Jamison) (Jamison 1990) which incorporated the major elements of the ISC report and established the following guidelines for a 2-year period:

1. All current land use allocations under existing land use plans for uses other than timber management will be continued.
2. No regular green timber sales will be offered in proposed habitat conservation areas (HCA) category 1 through 4. All timber sales will be surveyed using BLM timber sale survey protocol, and any new owl pairs within the zone requiring category 3 HCA areas will be protected as per ISC report recommendations.
3. Salvage sales may be offered in HCAs if the action is to have no effect on the owl or its habitat, or if through consultation with the FWS the sale is cleared for harvest.
4. Forest management practices, such as tree planting on previously logged units, seedling maintenance, site preparation, precommercial thinning, and fertilization would also be permitted in the HCAs during the 2-year period.
5. No regular green timber sales will be offered in the 109 spotted owl agreement areas established under the 1987 agreement between the BLM and ODFW, or in the 12 additional areas established under section 318 of Public Law 101-121. Timber salvage sales may be offered in the ODFW agreement areas only after the concurrence of the ODFW.
6. In planning timber sales outside category 1 and 2 HCAs consider unit placement, to the extent possible, to reduce or eliminate the impact on the existing habitat conditions for those forestlands which have mean dbh of at least 11 inches and a canopy closure of at least 40 percent. The intent of this guideline is to provide dispersal habitat for owls.

7. Prepare a preharvest/postharvest profile of the habitat conditions in the forest matrix (forestlands outside category 1 and 2 HICAs) using quarter-township assessment areas to describe the percentage of the area in "stands with a mean dbh of at least 11 inches and canopy cover of at least 40 percent" condition. Include the profile narrative, figures, and maps as part of the BLM's biological assessment package on the fiscal year 1991 and 1992 annual timber sale plan that is submitted to the FWS for consultation.
8. Comply with the provisions of the Endangered Species Act relative to the spotted owl by consulting on all actions that constitute a "may affect" situation on the species or its habitat. Implement the mandatory terms and conditions in the FWS biological opinion to minimize incidental take of owls and habitat and, as appropriate, implement recommended conservation measures.

The Jamison strategy remained in effect until September 11, 1991, when the U.S. District Court in Eugene, Oregon, enjoined the BLM from implementing the strategy until the BLM complies with section 7 of the Endangered Species Act by submitting the strategy for consultation to the FWS. Management of BLM lands in Oregon will be based on existing timber management plans until completion of new resource management plans in 1992. This court decision did not affect management on BLM lands in California or Washington.

Resource Management Planning

In Oregon, the BLM currently is formulating alternatives for its western Oregon districts. Draft resource management plans and an environmental impact statement are scheduled for completion in early 1992. The BLM is considering five alternatives including one that would emphasize high production of timber and other economically important values on all lands to contribute to community stability; one that would emphasize protection of older forests values such as dispersed nonmotorized recreation opportunities and scenic resources; and one aimed at maintaining biological diversity, such as fish and wildlife habitat, recreation, and scenic resources on all lands. The BLM plans to analyze the effects of each alternative on spotted owls. The BLM, in cooperation with the Forest Service's Pacific Southwest Research Station Redwood Sciences Laboratory, is working to develop a spatially explicit life history simulator (model) for the relative assessment of impacts of management scenarios on the northern spotted owl.

Management of spotted owl habitat in California is confined to the Ukiah District office (Table 2.6). Current planning efforts for the Ukiah District, Arcata Resource Area, are focused on completing the record of decision for the resource management plan. The record of decision will defer any further green timber sales or disposal of lands containing old-growth habitat pending the completion of a state-initiated habitat conservation plan (HCP) for the owl. The Redding Resource Area recently released its draft resource management plan and is analyzing comments. Timber stands in the two resource areas are generally less than 300 acres in size and only rarely adjacent to other agency lands. Six tracts have been designated old-growth research natural areas or areas of critical environmental concern. The BLM Ukiah district manager is a member of the northern spotted owl HCP steering committee and two BLM scientists are members of the HCP scientific committee.

The BLM Spokane (Washington) District office manages approximately 3,000 acres of forestlands within the range of the spotted owl. Owl management has been limited to project clearance, surveys, and protection of suitable habitat within known owl activity areas. No nest sites are currently known.

Present Status of Habitat and Trend

The ISC and the 1990 status review (USDI 1990) both referred to the major factors influencing the amount and distribution of owl habitat on BLM land. The major factors identified include scattered and checkerboard land patterns; past land management activities (primarily timber harvest); and natural occurrences such as forest succession, wildfire, and windstorms. This has created a mosaic patchwork of stands more than 80 years old as habitat for spotted owls. These stand sizes range primarily from 50 to 500 acres, with some exceptions of 2,000 to 5,000 acres. The remainder of the landscape is in recent clear-cuts or forest stands ranging from 5 to 80 years old. Clear-cutting is the predominant harvest practice used by the BLM on lands in western Oregon. Both clear-cutting and selective harvesting have been used on lands in southwestern Oregon and northern California. Only limited use of silvicultural practices has been experimented with to create or maintain spotted owl habitat.

In past years, the BLM has classified forest stands older than 80 years as spotted owl habitat, using forest age classes, size, and crown closure as the main criteria. Because these attributes may not provide an adequate characterization of suitable owl habitat, the BLM refined its habitat figures using forest operations inventory data combined with a quality check by resource area biologists. Table 2.6 illustrates spotted owl habitat on BLM lands in western Oregon with two habitat component levels identified representing levels of habitat quality.

BLM lands in the Ukiah District, Arcata Resource Area, consist of isolated blocks generally 40 to 3,000 acres in size imbedded in a private landscape. The private lands have been subjected to extensive harvest during the last decade and contrast with the older timber stands on the adjacent public lands, where most of the remaining owl territories are found.

Clear-cutting has not been practiced in the Ukiah District since 1981. Starting in 1982, the BLM has practiced the managed old-growth concept of forestland management on all timber sales. These guidelines provide for at least 10 percent of the site's potential basal area to be occupied by trees that have survived at least two 100-year rotation cuttings. These superdominant trees provide a base for future recruitment of snags and down debris. The structural elements of old-growth management include 1) large trees for shade and reproduction, 2) large snags for nesting, 3) large debris for nitrogen fixation and carbon recycling, and 4) coarse woody debris in the headwater areas of drainages for erosion control.

Estimates were made in the 1990 status review (USDI 1990) predicting the rate of decline of habitat during the next 10 to 50 years on BLM-administered land. Historic data showed a loss of approximately 475,000 acres during the last 20 years. Assuming the harvest rates prior to the listing of the owl, habitat would have been extremely limited within 30 years. However, since the 1990 listing, the actual timber sale level has been reduced to approximately 40 percent of

recent historical levels. This change is based on congressional direction and FWS biological opinions on BLM timber sales. Future figures could be reduced to even lower levels. However, BLM forestlands harvested in the late 1960s and early 1970s could be expected to begin providing limited spotted owl habitat in the next 50 to 60 years.

Inventory and Monitoring

The BLM in Oregon has been surveying its lands for spotted owls since the early 1970s. The percentage of BLM lands that have been inventoried by district ranges from 50 to 90 percent. Early inventories were neither complete nor uniform, although data were accumulated on historic locations of owls across the land base. After the completion of land use plans in 1983, a comprehensive monitoring plan was developed for Oregon and was put into operation in 1986. This has resulted in more consistent and complete data collection among districts. When surveys found and verified new locations, these were added to the list of sites to be monitored. The process is based primarily on locating and tracking owls over time. Oregon data from the period of 1988 through 1990 showed that 518 pairs were verified on BLM lands in western Oregon. Single owls or unconfirmed pairs were present at an additional 110 locations during this same period. More than 60 percent of the owls found were in the Roseburg and Medford Districts.

The BLM also implemented an intensive banding program in 1985 to mark individual owls. Through 1990, more than 1,800 owls were banded, nearly a third of them were juveniles. Results from the banding information will provide insights into longevity, movement, survival, and age at first breeding.

Inventories of northern spotted owl habitat in California since 1977 have been conducted as needed to survey timber harvest plans or other major land use actions. Complete documented survey data have been maintained only since 1988. With about 25 percent of the habitat surveyed in the Ukiah District, 20 pairs of owls (17 in the Arcata Resource Area and three on the Redding Resource Area) have been detected on BLM lands in California since 1988. Thirty percent of known spotted owl territories (7 of 17) in the Arcata Resource Area have been monitored continuously since 1987 by researchers from Humboldt State University, but no comprehensive monitoring program has been developed yet for California.

Applicable Law

The principal legislative mandates guiding management of these lands are derived from the O&C Act and the Federal Land Policy and Management Act (FLPMA). The O&C Act applies exclusively to lands in western Oregon, generally configured in an alternate-section checkerboard pattern. The O&C Act directs management of these lands for sustained-yield permanent forest production that contributes to economic stability of local communities and industries. In addition, other management requirements are for permanent timber supply, protection of watersheds, regulating stream flows, and providing recreation facilities. FLPMA provides multiple-use management direction and overall resource-management planning requirements for all lands administered by the BLM.

3. National Park Service

The following areas managed by the National Park Service (NPS) are known to contain northern spotted owls: North Cascades, Mount Rainier, and Olympic National Parks in Washington; Crater Lake National Park and Oregon Caves National Monument in Oregon; and Redwood National Park, Point Reyes National Seashore, and Muir Woods National Monument in California. Whiskeytown National Recreation Area in California also may be occupied by northern spotted owls. These areas provide up to 570,000 acres of suitable habitat, although none has been surveyed for owls. The NPS currently has no coordinated inventory and monitoring program for spotted owls.

Management Background

Management of areas of the NPS is generally compatible with that required for recovery of the northern spotted owl. In fact, Barry (1990) suggested that few environmental laws are more consistent with NPS objectives than the Endangered Species Act. The primary purpose of the act is to preserve for future generations endangered and threatened species and the ecosystems upon which they depend, while the goal of the NPS is to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations," (NPS Organic Act).

The policy of the NPS is to manage natural resources "with a concern for fundamental ecological processes, as well as for individual species," (NPS Management Policies 1988:4:1) as well as "identify and promote conservation of all federally listed threatened, endangered, or candidate species within park boundaries and their critical habitats." Active management programs will be conducted as necessary to perpetuate the natural distribution and abundance of threatened or endangered species and the ecosystems on which they depend (NPS Management Policies 1988:4:11).

Management actions will be in accordance with, and follow recovery priorities identified in approved recovery plans (NPS 1991:273). Habitat manipulation, species restoration, or population augmentation are "encouraged if identified as appropriate in the recovery plan and if such activities would result in a more representative distribution of the species within the park," (NPS 1991:274). Such management activities must "consider potential impacts on other native species" and "significant modification of habitat and landform is discouraged unless necessary to prevent extirpation or extinction of the species" (NPS 1991:274). All management actions for endangered or threatened species will be described and assigned priorities in the park's approved resources management plan.

Applicable law

The general authority under which the NPS operates is the NPS Organic Act (16 USC 1), which authorizes the NPS to "regulate the use of the federal areas known as national parks." See the statement of purpose of this act earlier in this section.

Each park also has its own enabling act. Congress has stated in the enabling legislation of most units that they have their own particular purposes and objectives. These may be broad or very specific. For example, Crater Lake was established in 1902 "as a public park or pleasure ground for the benefit of the

people of the United States." Redwood National Park, created in 1968, was established "to preserve significant examples of the primeval coastal redwood forests and the streams and seashores with which they are associated for purposes of public inspiration, enjoyment, and scientific study."

The Endangered Species Act applies to all national park system areas as it does to other federal lands.

4. Fish and Wildlife Service

Management Background

The U.S. Fish and Wildlife Service (FWS) administers several national wildlife refuges within the range of the owl. Two refuges in Oregon and two in Washington contain small parcels of suitable owl habitat. National wildlife refuges are managed in accordance with goals of preserving a natural diversity and abundance of fauna and flora on refuge lands and of preserving, restoring, and enhancing in their natural ecosystems all endangered and threatened species of animals and plants.

Since the northern spotted owl was proposed for listing, the FWS has conducted hundreds of conferences and consultations under section 7 of the Endangered Species Act concerning the land management activities of federal agencies within the species' range. Since publication of the proposal to designate critical habitat, the conference process also has been available with regard to effects of federal management on the areas proposed for designation. With final designation of critical habitat on January 15, 1992, consultation responsibilities were extended to these areas so designated.

Applicable Law

The FWS assists other federal agencies in fulfilling their obligations under section 7 of the Endangered Species Act. The act requires agencies to undertake programs for the conservation of endangered and threatened species and to ensure that their actions are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. Agencies must consult with the FWS on any action that may affect a listed species.

Consultation. The FWS conducts consultations at the request of an action agency to determine whether actions proposed by federal agencies are likely to "jeopardize the continued existence" of threatened or endangered species, or result in "destruction or adverse modification" of critical habitat designated for listed species. These phrases are defined in regulations (50 CFR 402.02) as follows:

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species."

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical."

The results of a consultation are summarized by the FWS in a biological opinion. During the consultation, the FWS estimates the amount of take of listed species that will occur incidental to the action. If the proposed action would result in incidental take, then the FWS may develop "reasonable and prudent measures" to minimize the level of take. The biological opinion states whether incidental take is authorized (assuming the reasonable and prudent measures are followed), and describes the permissible level of take. The description of allowable take is called an incidental take statement.

If the FWS concludes that the action is likely to jeopardize a species, or lead to the destruction or adverse modification of critical habitat, then the FWS attempts to work with the action agency to develop reasonable and prudent alternatives. Reasonable and prudent alternatives are designed to allow the action to continue without jeopardizing the continued existence of the species or resulting in the destruction or adverse modification of critical habitat.

"Reasonable and prudent alternatives refer to alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that the director believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat." (50 CFR 402.02.)

Agencies are required by the Endangered Species Act to follow the provisions of the incidental take statement and to implement the reasonable and prudent measures. The act also requires agencies to avoid jeopardizing any listed species or causing destruction or adverse modification of critical habitat. Agencies may act on their own conclusions, however, about whether a proposed action will have any of these effects; they do not have to accept the judgement of the FWS. Therefore, once consultation is complete, agencies may proceed with the action regardless of the outcome of the consultation as long as they follow the provisions of the incidental take statement and the reasonable and prudent measures (if any).

Further consultation is not required except in the following situations:

"Federal involvement or control over the action has been retained or is authorized by law and:

- a) If the amount or extent of taking specified in the incidental take statement is exceeded;
- b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
- c) If the identified action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or
- d) If a new species is listed or critical habitat designated that may be affected by the identified action." (50 CFR 402.16)

When a species has been proposed for listing or an area has been proposed for designation as critical habitat, a similar procedure, known as conference, is required. A conference results in an advisory report to the action agency, but does not provide an opinion regarding the likelihood of violation of section 7.

The FWS also enforces the Endangered Species Act's taking prohibitions and participates in conservation planning. Development of a conservation plan

that satisfies the act's requirements can be the basis for issuance of incidental taking permits to nonfederal land managers.

Prohibition against take. After the northern spotted owl was listed as a threatened species, private timberland owners requested guidance from the FWS on how they could harvest timber without violating the Endangered Species Act. Since the only requirement of nonfederal entities under the Endangered Species Act is the prohibition against take, the FWS issued guidance on the measures needed to avoid taking owls. The FWS believes, however, that the "survey and circle" approach described in that guidance does not provide adequate long-term protection for the subspecies. In addition, the FWS is concerned about the substantial costs being incurred by landowners providing these protective measures. One of the goals of the Recovery Team is to develop more efficient ways by which landowners may provide equal or increased protection for owls while incurring equal or lower economic costs. Some of the concerns about the take circles are described below.

1. Biological concerns.

- Although the take circles are a uniform size within a province, their contribution to recovery is variable. They differ in the amount and quality of suitable habitat they contain and in their placement across the landscape. Yet, the circles are protected equally, regardless of their actual contribution to recovery.
- Application of the take guidelines tends to encourage fragmentation of habitat. Landowners also have an incentive to cut habitat before an owl is found, reducing that habitat in the near term.
- The amount of habitat in the take circles is not optimal for recovery of the species.
- The spacing of the take circles is not optimal for contributing to recovery. The circles surround owls where they are currently located and, in some cases, they are spaced too far apart to allow for successful dispersal among them. Some circles overlap, creating clusters of pairs helpful in recovery, while other circles are isolated from the rest of the population by large expanses of unsuitable habitat.
- The take prohibition works most effectively to protect habitat where owls are most numerous, and does not effectively protect habitat, such as linkages among federal lands, in areas which currently do not contain owls.
- Surveys conducted to comply with the take prohibition provide only a portion of the data required for monitoring owl recovery. Surveys are generally conducted in areas of planned timber harvests and, though the results contribute to the assessment of owl populations, the surveys provide little information about habitat or population trends at the landscape level.

2. Land management concerns.

- Discovery of an owl forces the creation of another restricted harvest circle, and may result in unexpected decline in income. This serves as a disincentive for landowners to survey or provide owl habitat.

- Since landowners already face cutting restrictions within the take circles, they may hesitate to contribute what they perceive to be additional habitat toward conservation of the population.
- Compliance with surveys and circles is costly and limits landowners' ability to plan timber harvest schedules.
- Landowners are skeptical that a negotiated agreement to allow take under specified conditions will be as advantageous as simply complying with current take guidelines. Landowners also may perceive that the basis for a negotiated agreement is their current owl protection contribution, which they may perceive as excessive.
- Many landowners disagree with the FWS's interpretation of when take is likely to occur. The recent administrative rescission of the take guidelines for strictly procedural reasons has further led to the perception that the definition of take is unclear and uncertain. This hampers predictability of owl protection and land management.
- Mechanisms under the Endangered Species Act for authorizing take differ for federal and nonfederal parties. Nonfederal landowners face a more arduous and lengthy process, which includes formal public review, for receiving take authorizations than do federal landowners. Even when spotted owl circles are centered on federal land and the federal agency is given an incidental take permit for that owl, nonfederal landowners within that circle cannot receive permission to harvest until the landowners write protective management plans (under section 10 of the act) or until the FWS writes "special rules" allowing take under section 4(d).

The success of the prohibition against take in contributing to recovery is variable, and is dependent upon the province and existing conditions within owl home ranges. It is also dependent upon the application of the take prohibition guidelines by state regulators and the FWS. Each state has a different ability and capacity to apply the take guidelines based on differences in their regulatory frameworks.

Habitat Conservation Plans. The Endangered Species Act generally prohibits the "taking" of listed species. Take is defined in part as harm, harassment, or killing individuals of the species. Destruction of the species' habitat which ultimately results in harm or harassment to the species may also constitute a taking under the act. Prior to 1982, the only activities that could be exempted from the prohibition against take were scientific research, captive breeding, and similar conservation actions. In 1982, the act was amended to permit taking "if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity". In permitting such "incidental take," Congress hoped to reduce conflicts between listed species and private development and to encourage "creative partnerships" between the private sector and local, state, and federal agencies in the interest of endangered species and habitat conservation. An applicant for an incidental take permit must agree to institute appropriate conservation measures for habitat maintenance, enhancement, and protection, described in a habitat conservation plan (HCP). The FWS reviews the HCP and, before issuing a permit for the incidental take, must find that (1) the taking will be incidental; (2) the applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking; (3) the applicant will ensure that adequate funding for the plan will be provided; (4) the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild; and (5) other measures that FWS may require will be met.

5. State of California

Regulatory Programs

Forest Practices Act. The Forest Practices Act established a comprehensive system for the regulation and management of timberlands to assure that productivity is restored, enhanced, and maintained, and that the goal of maximum sustained production of high quality timber products is achieved while giving consideration to watershed, wildlife, recreational, and other important values related to forest ecosystems. The program applies to more than 7 million acres of state and private timberlands.

Rules adopted by the California Board of Forestry implement the provisions of the Forest Practices Act and the requirements of other statutes, such as the California Environmental Quality Act.

The forest practices regulatory programs and review process for timber harvest plans (THP) have been certified by the Secretary of Resources as functionally equivalent to environmental impact report and analysis under the California Environmental Quality Act. Before timber harvesting may commence, the Department of Forestry and Fire Protection must review and approve a THP which discloses information on the proposed timber harvest operation and its effects on the environment. A timber harvest plan may not be approved as proposed if there are feasible alternatives or mitigation measures available that would substantially lessen any significant adverse environmental impacts from implementation of the proposal.

1. Silvicultural Requirements

A THP must indicate which selected silvicultural methods are appropriate to the site conditions to protect environmental values. The plan is subjected to a review process that includes consultation with other departments, such as the Department of Fish and Game and California Water Quality Control Boards, and public review and comment.

2. Sensitive Species Listing Process

The California Board of Forestry identifies by regulation plant and animal species or subspecies that require special consideration in the review of THPs to avoid damage to their habitat areas. The process is similar to the listing process specified under the California Endangered Species Act.

The state forestry board regulations include specific requirements for protecting these species. The northern spotted owl is among the species for which these requirements apply.

3. Water Course and Lake Protection Zones

The water course and lake protection rules ensure protection of the water quality, beneficial uses, and biological characteristics of watercourses and lakes within timberlands. Within fixed protection zones timber operators are restricted or constrained (e.g., by prohibition of clear-cutting and limits on road building) to prevent discharge of materials and erosion in and around watercourses and lakes.

4. Cumulative Effects Assessment

The preparation of a THP must include an assessment of potentially significant cumulative impacts from the proposed timber harvest operation for a number of environmental variables. The assessment process must indicate whether the proposal, when considered with the impacts of past projects and reasonably foreseeable future projects, would result in significant adverse environmental impacts.

Evaluation of cumulative effects on biological resources includes identifying resources of concern, such as threatened and endangered species, sensitive species, important wildlife resources such as game animals, and specific components of wildlife habitat.

Mitigation measures and other protection are included in THPs as needed to avoid, reduce, or offset significant adverse cumulative effects. Direct and indirect effects resulting from the proposed action must be addressed. While the rule does not contain specific mitigation requirements, it does provide an analytical basis for requiring site-by-site protection if needed.

Evaluating potential timber harvesting impacts to northern spotted owls in the analysis of cumulative effects provides several benefits for owl conservation: 1) the impacts of a proposed timber operation are assessed in the context of past, present, and future projects in the same area; 2) impacts are assessed on broader temporal and spatial scales than those addressed by individual THPs and an assessment limited to direct impacts; and 3) the assessment process tailors the analysis to fit unique conditions of owl populations and habitat, information availability, and perceived threshold of impacts.

5. Specific Northern Spotted Owl Rules

The state forestry board has adopted specific rules for the protection and conservation of the northern spotted owl (emergency rules in August 1990; permanent rules in February 1991), which are designed to prevent take of northern spotted owls. Approval of any harvest plan that would cause significant long-term damage to the owl must be withheld. Other rules require a THP to provide specific information about owl habitat and owls within the proposed harvest area and adjacent areas. The California Department of Forestry and Fire Protection and the California Department of Fish and Game have developed a procedure whereby plans are reviewed and a determination is made whether the plan will result in a take. This process has the concurrence of the FWS.

6. Nonindustrial Timber Management Plan

As an alternative to THP review, the state forestry board has adopted rules to permit nonindustrial forestland owners holding less than 2,500 acres to submit long-term management and harvesting plans. The plans are required to prescribe uneven-age management of the forestland. The owner must submit management information regarding silvicultural methods, harvest scheduling, existing and future stand conditions, and other pertinent information. Using this option, spotted owl conservation needs can be integrated with timber harvesting and management of nonindustrial timberlands.

California Environmental Quality Act (CEQA). The CEQA is similar to the National Environmental Policy Act; before state or local agencies may approve

or undertake any project that may result in significant environmental impacts, they must review and disclose the potential impacts, adopt feasible mitigation measures, and adopt findings regarding the impacts of the proposed project.

California Endangered Species Act. The California Endangered Species Act of 1984 established a process whereby the public or the Department of Fish and Game may submit a petition to the Fish and Game Commission with a recommendation to list (or delist) as threatened or endangered, any native species or subspecies of plant or animal.

If a species is considered a candidate for listing, restrictions on import, export, take, possession, purchase, or sale go into effect. If the species is listed, additional restrictions regarding jeopardy, consultation with California lead agencies, required mitigation measures and commitment to conservation, protection, and enhancement go into effect. The northern spotted owl is not currently listed as a threatened or endangered species under this act.

Land Management

State Parks. Lands within state parks are administered by the California Department of Parks and Recreation to protect and perpetuate natural resource systems and values. Commercial resource development, including timber harvesting, is not permitted in state park units. There are 27 state park system units in the northern coastal portions of the owl's range. Eighteen of the units are known to support at least one owl territory. The Department of Parks and Recreation is participating in the California habitat conservation plan efforts for the northern spotted owl.

State Forests. The California Department of Forestry and Fire Protection administers the state forest system in accordance with a management plan approved by the state forestry board. The Jackson Demonstration State Forest is within the range of the northern spotted owl. It encompasses 50,000 acres that are used for demonstration and research experiments addressing fish and wildlife conservation needs, watershed protection measures, recreational uses and commercial timber harvesting. The state forest is completing a spotted owl and small mammal survey. Harvesting operations fall under the Forest Practices Act and must comply with all forest practices rules, including those prescribing protection for northern spotted owls under that act.

Protection from Fire. The California Department of Forestry and Fire Protection has primary responsibility for fire prevention and protection for the 32 million acres of state-responsibility lands. The department is responding aggressively to growing fire risks associated with prolonged drought and the movement of a significantly larger number of people to rural California. The department is particularly aware of the need to reduce the risk of large, catastrophic fires, such as those likely to affect conservation measures for the northern spotted owl.

Forestry Assistance. A number of forestry assistance programs for private landowners is coordinated through the Department of Forestry and Fire Protection, including the California Forest Improvement Program and the Federal Forest Improvement Program. These programs share costs of tree planting and forest management on nonindustrial forestland ownerships. These programs benefit the northern spotted owl by providing another means of establishing habitat over time on lands that might otherwise not be restored or might be converted to nonforest uses.

Assessment, Planning, and Monitoring

Timberland Task Force. The Timberland Task Force was established in January 1990, pursuant to legislative direction (Assembly Bill 1580) to develop a long-term, more comprehensive, process for addressing wildlife issues in the context of forestland management. The Timberland Task Force is charged with developing a coordinated base of scientific information for analyzing cumulative impacts on the biological diversity of forestland ecosystems, evaluating timberland habitat for its contribution to the overall maintenance of specific wildlife species, contracting for studies to validate wildlife models and develop mitigation, and identifying critical habitat areas and species of special status. The task force includes representatives from state and federal agencies.

The task force will report its recommendations to the governor and California legislature in 1992. The coordinated database will be used in reviewing individual timber harvest plans with regard to their cumulative impacts on wildlife. The database will include geographic information system (GIS) analysis of vegetation and habitat on forestlands (a pilot vegetation/habitat mapping project covering approximately 6 million acres within the range of the northern spotted owl will be completed in early 1992) and linkage with the state's Wildlife Habitat Relationships Database (WHR) to relate vegetation growth and yield models to possible land management options.

Developing from the initial work of the Timberland Task Force, a memorandum of understanding establishing an executive council to set guiding principles and policies regarding statewide efforts to conserve biological diversity was signed on September 19, 1991. This memorandum will provide the long-term framework for developing a statewide strategy to conserve biological diversity and coordinate implementation through regional and local institutions.

The Statewide Executive Council, chaired by the Resources Agency Secretary and consisting of state and federal agencies, will set statewide goals for the protection of biological diversity, and will encourage and assist the establishment of bioregional councils to achieve protection of biological diversity. Under this umbrella, a Klamath bioregion project addressing the range of the northern spotted owl in California is developing, and will build on the state habitat conservation plan.

Habitat Conservation Plans. The California Board of Forestry and Fire Protection initiated the state's habitat conservation planning (HCP) for the northern spotted owl in November 1990, anticipating a future application for an incidental take permit under the federal Endangered Species Act. This effort is in addition to the adoption of rules to ensure that timber harvesting on state and private lands in California would not result in a take of northern spotted owls.

The HCP and the associated environmental impact report/environmental impact statement are being developed under the guidance of a broadly based steering committee appointed by the state forestry board.

The steering committee operates under a set of objectives intended to promote development of a plan that fully meets the requirements of the federal Endangered Species Act while also limiting effects on private landowners and economic impacts.

The steering committee and a scientific committee currently are evaluating eight options, which resulted from extensive public scoping efforts and repre-

sent a range of levels of protection for the owl. The alternatives have been developed with the assumption that a comprehensive owl conservation strategy, such as the ISC proposal, would be implemented on federal lands. A draft HCP and associated environmental review documents are expected to be available for public review by May 1992.

Forest and Rangeland Resources Assessment Program. The Forest and Rangeland Resources Assessment Program (FRRAP) was established in 1978. The charge of the program is to describe and analyze the current conditions of California's forest and range resources base and to anticipate emerging management problems that require public or private action. The FRRAP is involved in a number of efforts related to spotted owl conservation, including long-term monitoring of forestland condition through periodic mapping; development of a statewide geographic information system for assessing impacts, uses, and trends; development and use of long-term timber harvest simulators that also track impacts on wildlife habitat; and economic impact estimation. The FRRAP provides primary staff to the Timberland Task Force and HCP efforts.

California Natural Diversity Data Base. The Department of Fish and Game maintains the California Natural Diversity Data Base, a computerized inventory of the locations and condition of endangered, threatened, and rare animal and plant taxa, as well as significant terrestrial and aquatic plant communities which was developed in cooperation with The Nature Conservancy. Project proponents and agencies consult the data base during project development and during the environmental review of various land management activities under the provisions of CEQA. Detailed northern spotted owl sighting information is maintained in an associated data base that is accessed on a "need to know" basis.

Natural Community Conservation Planning. Recent California legislation has established the natural community conservation planning (NCCP) process to meet the needs of threatened and endangered species and to provide protection for significant areas that support natural ecosystems and biological diversity. A memorandum of understanding signed on December 4, 1991, between the FWS and the State of California (Resources Agency and Department of Fish and Game) provides for sharing data and cooperatively developing an NCCP pilot program in southern California.

6. State of Oregon

Oregon has regulatory programs, technical assistance programs, land management objectives, and research that are aimed at conservation efforts for the northern spotted owl.

Regulatory Programs

Forest Practices. The Forest Practices Act (FPA) was enacted to assure the continuous growing and harvesting of forest tree species while protecting soil, air, wildlife, and water resources on 10.1 million acres of private, state, and county forestlands. It regulates commercial forest operations to ensure forest practices that maintain and enhance the benefits of all forest resources.

Under the FPA, threatened and endangered fish and wildlife species are inventoried. This resource inventory will be used to inform forest landowners of their obligation to protect the owl; furthermore, it may help local government protect some natural resource sites in compliance with Oregon's land use laws.

Spotted owl nesting sites and activity centers are protected under the FPA rules. Proposed and ongoing forest operations within 1 mile of a spotted owl nest site or activity center must obtain approval of a written plan from the Oregon Department of Forestry before proceeding. Harvest operations must leave a core area comprising 70 acres of the best available habitat in the vicinity of a nest site. The Oregon Department of Fish and Wildlife (ODFW) provides site-specific assessment and advice to landowners when owl sites are identified on nonfederal lands. Overall, forest practices that would significantly reduce suitable habitat in the core area are not allowed. Forest practices that would disturb owl nesting behavior and possibly result in nest failure must not be carried out during the breeding season. In addition to complying with the provisions of the FPA, landowners also must comply with the federal Endangered Species Act.

Oregon Endangered Species Act. The northern spotted owl is listed as a threatened species under Oregon's Endangered Species Act. This act authorizes the Oregon Fish and Wildlife Commission to conduct research, census, law enforcement, propagation, transplantation, and habitat acquisition and maintenance for listed species. Agencies must consult with the ODFW before taking any action that may harm owls on state-owned lands.

Statewide Land-Use Planning Program. The State of Oregon has an extensive program for land use planning. While it is not the first or only statewide planning effort, it is one of the most comprehensive. The program has many aims and objectives, but the most important ones relating to protection of threatened and endangered species are contained in Goal 4 (Forest Lands) and Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) of the program.

Land Management

Department of Forest Land Management. The Oregon Department of Forestry is responsible for the management of nearly 786,000 acres of forestland to secure the greatest permanent value to the state. Production of timber on a sustained-yield basis is established as the primary goal, but due consideration must be given to all other appropriate uses of the land.

Of the 786,000 acres managed, 654,000 acres are Oregon Board of Forestry lands (county trust lands) and 132,000 are Common School lands. Aside from timber harvesting, the state forester is authorized to permit other forest uses such as recreation, watersheds, and fish and wildlife conservation. Those lands which, in the opinion of the state forester, have exceptional scenic and/or fish or wildlife habitat values, and on which commercial forest management would significantly degrade those values, are classified as "conservancy." Twenty-six thousand acres of Oregon forestland are classified as conservancy and reserved from timber management. Another 24,000 acres of state forestland are classified as noncommercial (not capable of sustaining timber harvesting) and also are withdrawn from timber harvesting.

Land Acquisition, Sale, and Exchange. The Oregon Board of Forestry acquired title to lands during the 1930s and 1940s from counties that had foreclosed on the lands for nonpayment of taxes. There is an implicit trust arrangement with the counties requiring payment to the counties of a share of the revenues generated by the land-management activities conducted on these lands. More than two-thirds of these lands are in the Tillamook State Forest, located primarily in Clatsop and Tillamook Counties. The county court or board of county commissioners of any county in which such land is situated also must approve exchanges; only after this approval may the exchange be consummated.

Under Oregon law, the primary objectives for managing Oregon Board of Forestry lands are to 1) generate revenue for county governments and local taxing districts; 2) make raw materials available on a sustained-yield basis to help meet demands for forest products; 3) obtain the greatest permanent value for Oregon; 4) provide community stability; 5) encourage efficiency in harvesting and processing; 6) encourage full economic utilization of the forest resource; and 7) provide employment.

The State Land Board holds title to the Common School lands. About two-thirds of the acreage are located within the Elliot State Forest in Coos and Douglas Counties, with the balance scattered in 30 other counties. The state forester manages the Common School lands under a contract with the State Land Board. The primary objective for the management of these lands is to generate income for the Common School Fund consistent with sound land and timber management practices. The State Land Board and the Oregon Board of Forestry each are required separately to approve exchanges by resolution.

Forestry Assistance. This program helps Oregon's private forest landowners meet their resource management objectives. This includes increasing forest growth and harvest potential to help ensure future supplies of timber and other forest products, promoting forest health, and enhancing and protecting fish and wildlife, soil, air, water, recreation, and aesthetics. Technical advice on applying the principles of integrated pest management, minimizing disease mortality and growth loss, forest management, and wildlife enhancement is provided upon request to private forest landowners.

Other Public Forestlands. Oregon's state parks include 74,000 acres of forestland withdrawn from timber production. Some of Oregon's parks, including Silver Falls and Saddle Mountain State Parks, provide suitable habitat for northern spotted owls. Several of the coastal state parks adjacent to federal lands may provide additional habitat.

The ODFW owns 30,000 acres of forestland devoted to producing wildlife habitat. County and municipal governments also have withdrawn 36,000 acres of their 146,000-acre timberland base.

Wild and Scenic Rivers. The federal Wild and Scenic Rivers Act designated 40 rivers in Oregon for inclusion in this system. Additional segments of these and other rivers are protected by the Oregon Scenic Waterways Act, administered by the Oregon Parks and Recreation Department. The Oregon Scenic Waterways Act protects the character of the rivers for fish, wildlife, and recreation.

Governor's Watershed Enhancement Board. The Governor's Watershed Enhancement Board provides technical assistance and grants for projects that focus on improvements to streams and upland areas of watersheds. These improvements, such as the enhancement of riparian areas, also may provide some owl habitat.

Research

Oregon Department of Fish and Wildlife is engaged in a project to assess the viability of northern spotted owl pairs on state-owned lands. Researchers are banding owls to track them over time. The focus of the study is spotted owl turnover and reproductive rates.

Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative research effort among several groups, including the Forest Service's Pacific Northwest Experiment Station and the College of Forestry at Oregon State University. Among the goals of the COPE program are conducting large-scale operational testing of forest management strategies, developing methods to assess the effect of various riparian and reforestation management systems on water, timber, and wildlife, and making scientific information more accessible to forest managers in the region. The COPE program currently has proposals to study several nontraditional silvicultural methods for simultaneously producing timber and wildlife values.

Oregon State University's College of Forestry's research forest is being used by a group of researchers to conduct a study entitled *New Perspectives for Management of Timber and Mature-Forest Wildlife in Douglas-fir Forests*. Researchers are examining different silvicultural systems that might enable foresters to manipulate stands to produce the kind of habitat needed by interior-forest species like the spotted owl.

7. State of Washington

Existing programs in Washington contributing to or having the potential to contribute to owl conservation include forest practices and land use regulations, management of state-owned lands, land acquisition, research, and various landowner assistance or incentive programs. In the past 2 years, considerable efforts have been made that have benefitted spotted owls through administration of forest practices regulations and cooperative planning for certain state-owned lands.

Regulatory Programs

State Forest Practices Act and Regulations. The Forest Practices Act and its implementing regulations are intended to afford protection to forest soils, fisheries, wildlife, water quantity and quality, air quality, recreation, and scenic beauty, coincident with maintenance of a viable forest products industry. The regulations, administered by the regulatory branch of the Department of Natural Resources, apply to 12 million acres of state and private land.

Timber harvest, road construction, and chemical spray on "lands known to contain a breeding pair or the nest or breeding grounds" of a federally listed species, or within the federally designated critical habitat of such species are subject to review under the State Environmental Policy Act (SEPA). "Lands known to contain" currently is interpreted to include all occupied suitable habitat subject to federal prohibitions on taking.

SEPA review entails information gathering, including owl surveys, and findings as to significant adverse environmental impacts. Surveying protocols and interpretation of results are provided by the Washington Department of Wildlife, which also maintains a data base documenting locations of all known owl sites in Washington.

Substantive forest practice permit decisions under SEPA require a balance between avoiding or mitigating identified adverse impacts and maintaining a viable forest products industry. Therefore, while state permit decisions currently reflect the biological thinking that was embodied in take guidelines adopted by the FWS, decisions may diverge from those guidelines in some respects. Nevertheless, state permittees are not relieved of any responsibilities

they may have under federal law. Several hundred permit applications were affected in some way during 1990 by Washington regulatory requirements related to the northern spotted owl. The regulations also provide protection to nontimber resources, including wildlife habitat, within designated riparian areas.

Washington Environmental Policy Act. This law is similar to the National Environmental Policy Act. Implementing regulations require environmental analysis and public review, and set substantive environmental goals for all agencies.

Local Zoning and Land Use Control. Local government permits are required for land use conversion, clearing and grading, and building construction. Permits generally are subject to SEPA analysis.

Wildlife Laws. Pursuant to Washington's wildlife laws, the state Wildlife Commission may by rule designate a species of wildlife as endangered. Hunting of or trafficking in endangered wildlife species is prohibited. The northern spotted owl is listed as endangered under Washington law.

Land Management

State Lands—Federally Granted Trusts. These lands were granted to Washington by the federal government to be managed in trust for the financial benefit of schools and other legally designated beneficiaries. About 1.3 million acres of forestland are currently in this ownership. Common law requires the state, acting through the Department of Natural Resources, to exercise the same prudence a private person would exercise in managing his or her own land. Case law requires undivided loyalty to the trust beneficiaries. Forested trust lands are managed on a sustained-yield basis. Trust lands are subject to the same regulatory requirements as those of other landowners. Beyond regulatory requirements, wildlife habitat objectives are incorporated into management, consistent with trust requirements.

State Lands—Forest Board. State statute created this state ownership of approximately 620,000 acres. These lands, mostly second-growth, are dedicated to perpetuate the forest resource. Revenues from management benefit county junior taxing districts and the state general fund. Case law indicates that the state has a trust relationship to county beneficiaries.

Commission on Old-Growth Alternatives. In June 1989, this broad-based citizens' commission made consensus recommendations to the Department of Natural Resources on management of old-growth forest on state lands on the western Olympic Peninsula. Recommendations included a 15-year harvest deferral on 15,000 acres of the most critical owl habitat, acquisition from the trusts of 3,000 acres of land with high ecological value, creation of a 260,000-acre experimental forest and a forest research center, and calculation of a sustained-yield level for these lands distinct from other state lands. These proposals are in various stages of consideration and implementation.

Industrial Lands. This is the largest nonfederal forestland ownership category in Washington, responsible for more than half of the total state timber supply in recent years. Although managed to provide economic returns, industrial lands are subject to the state forest practices regulations described earlier. In some cases, relatively large contiguous ownership blocks are conducive to effective voluntary management for some nontimber values.

including wildlife. In other cases, scattered or checkerboard ownership with federal lands complicates management.

Nonindustrial Private. Nonindustrial lands comprise almost a quarter of the forestland ownership in Washington. These lands may or may not be managed primarily for timber. Because of their location close to human populations, management of these lands has important effects on supply of nontimber values. However, due to their small size and generally young timber, opportunities for management of these lands to promote owl conservation are limited.

Land Acquisition

Washington Wildlife and Recreation Coalition. Created in 1988 as a coalition of citizen groups, this organization lobbies the state legislature for funds to bring high priority habitat and park lands into public ownership. To date, \$113 million have been appropriated for these purposes.

Trust Land Purchase Program. In 1989-90, the Washington legislature appropriated approximately \$150 million in state general funds to purchase environmentally sensitive state trust lands. When completed, these purchases will bring about 60,000 acres into conservancy management. The value of the timber (usually about 90 percent) goes to the same trust accounts as does timber sale revenue. The land value goes to purchase replacement trust lands.

Other Preserved Lands. Several hundred thousand acres of state lands are managed in a preserve status as natural area preserves, state parks, wildlife areas, and under related designations. Periodically additional lands are added to these categories. Some of these lands may contribute to owl habitat, but for the most part, they are of small individual size.

Assistance Programs

Washington provides a number of programs of technical and financial assistance to small-acreage forest landowners to encourage improved management of lands for a variety of objectives, including timber supply, watershed protection, and wildlife habitat. In the future, additional funds are expected to be available to address a broader range of resource objectives.

Incentive Programs

Several programs of state and local government currently provide a variety of tax and other incentives for land management that promote open space, farmland preservation, and other resource objectives. These programs may contribute incidentally to owl conservation, but would need expansion and direction to make more substantive and intentional contributions.

Research

The Department of Natural Resources and the Department of Wildlife conduct and participate in research programs concerned with the spotted owl. For the most part, these research programs are funded and led by federal resource agencies.

8. Indian Land

Indian reservation lands have been set aside for the exclusive use and benefit of Indian people pursuant to treaties, statutes, and executive orders. In addition, Indians retain treaty-secured cultural, economic, and hunting and fishing rights within lands ceded to the United States. Indian Reservation lands are held in trust by the United States, with the Secretary of the Interior having the principal responsibility for maintaining that trust. Each reservation is governed by a sovereign tribal government. Tribal governments have among their many sovereign powers the right to regulate the uses of land and resources within their reservation boundaries, including the use and management of fisheries and wildlife resources and habitat.

Indian people revere all lands, forests, and wildlife. They have managed their lands prudently for centuries. They recognize the environmental, cultural, and spiritual values of those lands, as well as the economic values and the importance of appropriate forestland management to wildlife. They have taken and will continue to take measures to protect reservation wildlife populations, including the spotted owl. Given this historical perspective, the Tribes are voluntarily managing portions of their reservation trust lands in a manner consistent with the northern spotted owl recovery effort. These voluntary contributions are made because the protection of all species — including spotted owls — is ingrained in Indian culture.

Within the range of the northern spotted owl, there are six Indian reservations that contain northern spotted owl activity centers: the Yakima Indian Reservation, located in the eastern Washington Cascades province; the Quinault Indian Reservation, located in the Washington's Olympic Peninsula province; the Warm Springs Indian Reservation, located in the eastern Oregon Cascades province; the Grand Ronde Indian Reservation, located in the Oregon Coast province; the Hoopa Valley Indian Reservation, located in the Klamath province of California and the Round Valley Indian Reservation located in the California Coast province. The following accounts of contributions to owl recovery were provided by the respective Tribes.

Yakima Indian Reservation, Washington

Timber harvests on the Yakima Indian Reservation are done almost exclusively under uneven-aged management prescriptions. This reduces impacts to suitable owl habitat while allowing harvesting to proceed. The reservation contains approximately 500,000 acres of forested habitat, of which about 50 percent (250,000 acres) currently is classified as suitable owl habitat. Typically, the northern spotted owl habitat on the Yakima Indian Reservation lies within a band approximately 30 miles (north to south) by 25 miles wide. This band starts near the Cascade crest at elevations below 5,000 feet and extends east until it reaches pure ponderosa pine timber stands. Within that habitat there is an existing block of 60,000 acres of prime suitable habitat that is in Tribally designated reserve status. To date only about 25 percent of the total suitable habitat and less than 5 percent of the reserved area habitat have been surveyed for owls. Twenty-four activity centers have been located during 1989-1991 owl surveys. At a minimum the tribal biologists estimate a total of at least 50 nesting sites will be found when surveys of all owl habitat have been completed.

The Yakima Indian Nation has a large, effective, fisheries and wildlife staff that reviews all on-reservation activities that may have environmental impacts.

Currently, the Yakima Indian Nation employs 14 full-time biologists and wildlife technicians on northern spotted owl inventory, monitoring, and habitat utilization studies. Data from these studies will yield valuable insights into the compatibility of uneven-aged forest management techniques in maintaining spotted owl habitat suitability.

Quinault Indian Reservation, Washington

Under the Indian Allotment Act the 208,000-acre reservation was allotted to individual Indians in 40- and 80-acre parcels. In order to obtain quick cash many of the allottees either obtained fee patents and sold the land to non-Indian timber interests or demanded that their timber be harvested at an accelerated rate. By 1987 the Quinault Indian Nation owned less than 15,000 acres of its 208,000-acre reservation. By 1991 this ownership had increased to nearly 54,000 acres. The Nation's aggressive reacquisition of its reservation was enhanced by the passage of Public Law 100-638. This law returned a portion of the northern boundary of the reservation to the Nation because of a previous survey error (12,000 acres of actual ownership and 5,400 acres along the eastern boundary of the reservation in which 45 percent of the revenues are pledged to the Nation). A prime stipulation in P.L. 100-638 was that revenues generated from the harvest of timber from the north boundary area must be used by the Nation for consolidating land ownership within the Quinault Reservation. This Act is proving to be very successful and will enable the Nation, in the long term, to better manage wildlife and fisheries throughout the reservation.

Spotted owl surveys have been completed on all suitable habitat within the reservation. Only one activity center has been located. This center is in the north boundary area. Harvest within this area will be adjusted to protect this activity center core as long as it remains occupied. This activity center is adjacent to the Olympic National Park, which provides the majority of suitable habitat in the area.

It should be noted that the Quinault River valley (approximately 50 square miles on the reservation) and the river's many tributaries form the most important reservation resource to the Quinault people. Preservation and conservation of five species of salmon, two species of trout, and others always will be a main Quinault objective. All other wildlife in this area also are considered in the management scheme. Because the Quinault Reservation originally was allotted to individual Indians in 40- and 80-acre parcels, management of the area as a single unit historically has been difficult. To protect this resource, the Quinault Nation has placed a high priority on consolidation of the river valley into Tribal ownership through land purchase. With consolidated ownership, the Tribe will effect a more consistent and improved riparian zone management. The valley will continue to offer wildlife and fish protection as the primary management objective.

Warm Springs Indian Reservation, Oregon

Currently, 40 percent of the habitat suitable for northern spotted owls has been surveyed on the Warm Springs Indian Reservation. Seventeen activity centers have been located, primarily in the northwest portion of the Reservation.

The Confederated Tribes of Warm Springs voluntarily have acknowledged the designation of 18,722 acres to be managed for owls as a "Warm Springs Special Habitat Preservation Area" in the southern end of the Reservation.

This area is a portion of one of several larger Tribal conditional use areas, which are limited-entry set-asides. The primary function of this area is to serve as a connecting corridor and habitat expansion between two designated conservation areas (DCAs) on the Deschutes National Forest.

On a short-term basis, other suitable owl habitat will be managed to maintain some owl activity centers primarily centered on and around the 60,549 acres of Tribal conditional use areas, including the area discussed above. Additional restricted land use occurs on riparian zone "A" lands, which consist of 21,086 acres where timber harvest is not allowed and two extensive management zones; one zone contains 7,224 acres where timber harvest is not allowed, and a second zone contains 7,418 acres of 200+-year extended age harvest rotation under uneven-aged management prescriptions. All these set-aside or special management areas contain suitable owl habitat. All these special management areas consist of 96,277 acres of forested land or 25 percent of the Confederated Tribes' total forest resource.

On a long-term basis, the Tribes will mesh owl protection into their overall wildlife management plan in such a manner as to contain all the necessities of owl survival.

Grand Ronde Indian Reservation, Oregon

The entire reservation has been surveyed and only small amounts of suitable northern spotted owl habitat exists. All of this suitable habitat is in second-growth stands with the majority of the area located on the eastern part of the Reservation in the Coast Creek drainage. The Coast Creek drainage has been occupied by a successfully breeding owl pair since 1974. An additional resident bird may reside on the western part of the Reservation. Spring 1992 calling will determine if the bird found this year is a resident bird. Much of the surrounding Forest Service and BLM timber stands in the Coast Creek area are now or are approaching suitable habitat conditions for northern spotted owls.

The enabling legislation establishing the Grand Ronde Indian Reservation has as its principal purpose to provide economic and cultural stability for the restored Grand Ronde Tribe. One of the terms of the Grand Ronde Reservation Act provides that, beginning September 1988 and for the following 20 years, 30 percent of all timber revenue is to be set aside for economic development primarily in Yamhill, Polk, and Tillamook Counties. Given the above situations, the Tribe and U.S. Bureau of Indian Affairs have conducted on-the-ground surveys with the FWS to explore alternatives that will provide protection for northern spotted owls and allow a metered harvest of timber from the Coast Creek area. This agreed upon action was begun in 1991, and will continue as long as necessary.

Hoopa (Hupa) Valley Indian Reservation, California

Owl surveys have located 27 activity centers within the reservation. Voluntary consultation (meeting section 7 requirements) with the FWS has been and will continue to be completed prior to timber harvests.

Approximately 6,000 acres of the total 88,000 acres of the reservation are inherently unsuitable for northern spotted owls (natural prairies, urban areas, water bodies, etc.). Of the remaining 82,000 acres, approximately 39 percent is designated as reserves, cultural sites, stream zones or as the Hoopa Valley Wild and Scenic River view shed (Valley View Shed) along the Trinity River.

where timber harvest is limited to partial cutting. The Valley View Shed is approximately 2 miles wide (17,000 acres) and serves specifically as a view shed to the Trinity River but also effectively serves to connect DCAs on Forest Service land north and south of the reservation.

The principal protection provided to wildlife and fish species on the reservation is the maintenance of stream protection zones which are up to 400 feet wide. Stream protection zones include 4,700 acres. The Tribe is concerned with the protection of threatened and endangered species of fish; wildlife and plants; and also culturally important species such as, chinook and coho stocks, lampreys, fishers, pileated woodpeckers, acorn woodpeckers, bald eagles, ospreys, Port Orford cedars, and others.

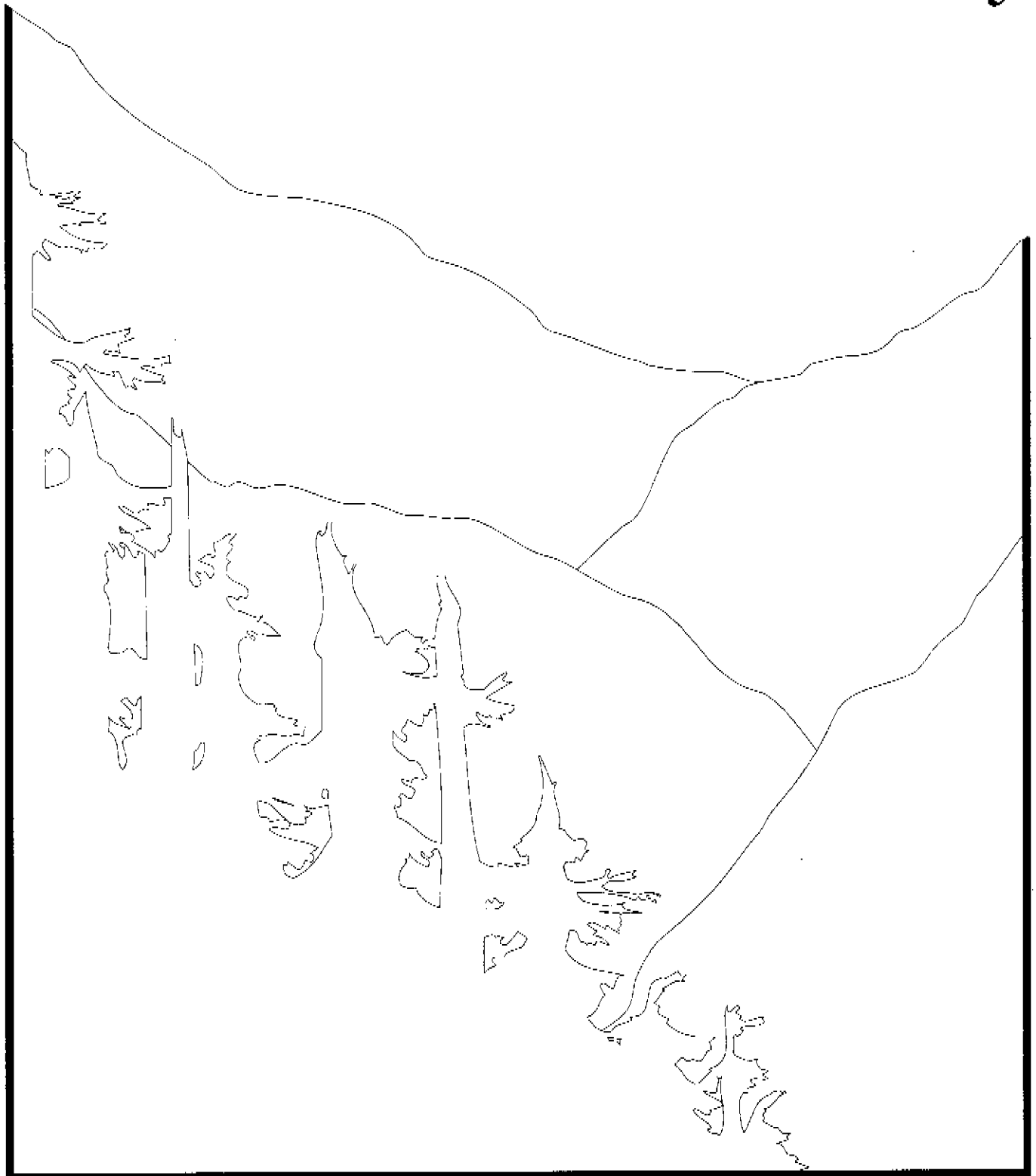
Round Valley Indian Reservation (Covelo Indian Community), California

A wildlife management survey has been initiated to survey all wildlife species on the Round Valley Indian Reservation. A spotted owl survey was conducted in the 1991 season. Within the 30,000-acre reservation a survey was conducted on land recently purchased — 11,304 acres purchased with a timber cutting right easement where conifers more than 11 inches in diameter remain the property of the prior landowner. This resource area had one spotted owl activity center. If harvest is not undertaken under the easement and after a complete survey of the reservation has been done, the Tribe will reevaluate its management to provide protection for this activity center.

The Tribe has a new Fish and Wildlife Program that works in conjunction with the Natural Resource Program to manage and protect its wildlife resources within the reservation. For now, the Tribe will manage for the northern spotted owl and continue to inventory this species habitat and will develop its own management plan.

Chapter III

Recovery



III.

A. Recovery Objective and Delisting Criteria

The objective of the recovery plan is delisting of the northern spotted owl throughout its range. The major threats to the subspecies, identified in the listing decision (55 FR 26114), were that suitable habitat was unprotected and decreasing throughout the range. Evidence was presented that some owl populations already were declining as a result. Delisting should not be considered until adequate suitable habitat has been protected. In addition, evidence should be available that owl populations are stable or increasing and are unlikely to become threatened again in the foreseeable future.

Four criteria are described here that must be met before delisting is considered. The criteria were designed to provide a basis for consideration of delisting, not for automatic delisting. The final decision about delisting should be made only after thorough review of all relevant information by the FWS. Delisting should not be considered in any part of the range for a minimum of 8 years. In most parts of the range, habitat and populations still are declining. Declines are expected to continue even after recovery recommendations are implemented. Therefore, in most parts of the range delisting probably will not be appropriate for substantially more than 8 years.

The recovery plan provides numerous specific recommendations that the Recovery Team believes must be implemented to achieve the conditions under which delisting would be appropriate (section III.C.4.). The Recovery Team recognizes, however, that new information may become available permitting the refinement and modification of these recommendations. The Recovery Team believes that the delisting criteria *should not be modified* (with the possible exception of criterion no. 2) even if specific recommendations change.

Delisting may be considered for all or part of the range. The borders of the area being considered for delisting should follow the borders of the physiographic provinces shown in Figure 2.2. "Area," in the delisting criteria descriptions refers to the area being considered for delisting.

1. Owl populations and owl habitat in the area have been monitored with a scientifically credible monitoring plan for the preceding 8 or more consecutive years.

A rangewide sampling plan should be instituted to monitor the progress of recovery. The plan should be designed using existing information, should provide information to modify the recovery plan as appropriate, and should serve as the basis for delisting once populations have recovered. Appendix A describes such a plan and indicates that collecting the needed data can be done at a reasonable cost. Appendix A also provides additional details about the specific requirements the sampling plan should meet, contains technical suggestions for efficient sampling methods, and explains the basis for the Recovery Team's conclusion that data should be available for a minimum of 8 years before delisting is considered.

2. The population has been stable or increasing during at least the last 8 years, as indicated by both density estimates and demographic analyses, in all parts of the area that would be considered significant under the Endangered Species Act.

Delisting a threatened population while it is declining would be difficult to justify. This is particularly true with northern spotted owls because evidence that populations were declining was one of the major reasons for listing the subspecies. These statements apply to the total population in the area being considered for delisting, or to any subpopulation that would be considered "significant," and thus would qualify for protection under the Endangered Species Act. The Recovery Team recognizes, however, that suitable habitat in the matrix—and owl populations—are likely to decline, and several decades may be required before populations stabilize completely, even if recovery is proceeding as anticipated. The Recovery Team believes that delisting eventually might be appropriate if the populations in protected areas were stable or increasing, even if the overall population still was declining slightly. The criteria for delisting under these conditions are difficult to specify precisely at this time, and doing so may be unnecessary if habitat protection in the matrix is integrated successfully with other forest activities (section III.B.2.). For these reasons, the Recovery Team has not attempted to specify the exact criteria for delisting while the population still is declining at a small rate.

State-of-the-art methods should be used to estimate population trends. Methods that would be appropriate at present are described in Appendices A and C.

3. Regulatory mechanisms or land management commitments have been implemented that provide for adequate long-term protection of breeding, foraging, and dispersal habitat, as described in section III.C.4., recovery goals and strategies for each province.

Delisting would be followed by loss of protection under the Endangered Species Act. Adequate protection through alternate means is essential before delisting. For example, management plans for federal land should provide adequate assurances of habitat protection prior to consideration of delisting. The form of these regulations and commitments should be determined during the coming years and will vary across the range. The Recovery Team therefore has not attempted to specify the form of the protection precisely. Reasonable assurance must exist that the conditions which have brought about population stability will be maintained, or, if necessary, improved during the foreseeable future.

4. The population is unlikely to need protection under the Endangered Species Act during the foreseeable future.

Populations that are temporarily stable but likely to decline again in the foreseeable future cannot be considered recovered and should not be delisted. *Detailed analyses of the likelihood that the population will remain stable or increase must be carried out before delisting.* The analyses should include observed and anticipated effects of a) fluctuations in abundance, fecundity, and survivorship; b) movements by birds within the area and to or from surrounding areas; c) changes in habitat including ones due to catastrophic events; d) loss of genetic diversity; and e) any other threats to the population whose effects might be significant. These analyses are particularly important for small populations.

III.

B. Principles Followed in Developing the Plan

1. Strategic Principles

Adequate assurance of recovery must be provided.

Secretary Lujan's letter directed the Recovery Team to prepare a plan which would "bring the owl to the point at which it will no longer need the protection of the Endangered Species Act." The directive to the Recovery Team recognized the "biological imperative" in the Endangered Species Act. No plan would be acceptable unless it provided adequate assurance that recovery would be achieved. Proposals for recovery were evaluated first to determine whether they provided adequate assurance of recovery. This evaluation was made without regard to economic implications of the proposal, and all proposals were required to meet this biological imperative prior to being given further consideration.

The plan should minimize social and economic costs.

The Recovery Team attempted to develop a plan which, while meeting the requirement of achieving recovery, would recognize and try to reduce the overall cost and would distribute this cost in an equitable manner across the region. For example, the Recovery Team made an intensive effort to place DCAs in locations where timber yield already was reduced (e.g., national parks, wilderness areas); efforts were made to distribute DCAs in a way that reduced adverse effects on timber-dependent communities; and analyses were carried out to identify activities within DCAs that might produce economic returns without reducing the assurance that recovery would occur.

The plan should be comprehensive.

Secretary Lujan directed the Recovery Team to develop a plan that "will serve as a guide to future federal, state and private activities affecting the owl." These activities will include research, monitoring, habitat protection, development of conservation plans, and numerous other efforts to bring about recovery. The Recovery Team attempted to integrate all of these activities into a single, well-coordinated plan for achieving recovery using all tools available under the Endangered Species Act.

All contributions to recovery should be recognized.

Important contributions to recovery are being made on nonfederal land and on federal land outside of DCAs. Some of these contributions are required for recovery, but others may provide higher levels of protection than are needed to assure recovery. These measures should not be required, and if they are contributed voluntarily, then the possibility of requiring less contribution from other sources should be investigated. This approach is consistent with the goal of minimizing the cost of recovery, and may be particularly important as an incentive for nonfederal landowners to find owls and develop long-term conservation programs for them.

Needs of other species should be considered.

Secretary Lujan directed the Recovery Team to consider "effects on other threatened and endangered species and those species which might be listed in the future." The Recovery Team attempted to identify these species and the requirements of a select group of priority species. Efforts then were made to ensure that the recovery plan provided this protection to the maximum extent practical without increasing the overall cost. The plan also contains additional information on the status of these species. The Recovery Team believes that landowners and managers may want to consider these other species in an effort to reduce the long-term costs of protecting species in these ecosystems.

The plan should be responsive to new information.

As new information is produced by the monitoring and research program, more efficient ways to bring about recovery may be developed. New data may indicate that DCAs need to be larger or smaller; modification of the monitoring program may be required; improved silvicultural methods may be demonstrated to create and maintain owl habitat, or for integrating timber production with owl protection; and new, more effective administrative procedures may be devised. The Recovery Team wants to encourage the development and implementation of these improvements. Specific recommendations are included for revising the plan periodically and for assuring that proposed modifications to the plan are considered fully and implemented as appropriate.

2. Biological Principles

This recovery plan is based on biological principles that are accepted widely by conservation biologists. The application of these principles to northern spotted owls first was described in the Conservation Strategy of the Interagency Scientific Committee (Thomas et al. 1990). The most important of these principles are that 1) species are more secure from extinction if habitat and local populations are distributed across their entire range; 2) providing for species in large habitat blocks is superior to providing small blocks; and 3) movement of individuals throughout the landscape is vital to the maintenance of all local populations within the range. A summary of the reasons behind each of these principles and their application to northern spotted owls follows.

The risk of local or widespread extirpation of northern spotted owls will be reduced by managing for owls across their entire range and the variety of ecological conditions within that range.

Four primary reasons can be cited for the importance of maintaining the full range of the species. First, any significant range reduction most likely would reduce the total number of local populations in the species' metapopulation. The security of the metapopulation is related directly to the number of local populations. A reduction in local populations increases the risk of extinction for the whole metapopulation. Second, a reduction in range also would reduce the overall range of environments occupied by the species, making the species more vulnerable to environmental stochasticity. Habitats at different elevations, in different forest types, in different ownerships, and in different parts of the owl's geographic range may act as refugia for the species in the face of catastrophes, rapid environmental change, chronic degradation of habitat from causes such as forest diseases, or unforeseen changes in interactions among species. Populations distributed across the geographic and ecological conditions within the range provide a higher likelihood that the subspecies will survive such events.

For these two reasons, Thomas et al. (1990) concluded that species well-distributed across their range are less prone to extinction than species confined to smaller portions of their range. Third, range reduction around the fringes of a species' geographic or elevational range could have serious consequences because these areas are often the sites of the most rapid adaptations within a species. Eliminating the fringes of the range might reduce the evolutionary capability of the species. Fourth, the elimination of the geographic or elevational fringe portions of a species' range might be considered unwise in the face of possible widespread climatic changes, especially where the direction and magnitude of those changes are uncertain. For example, some scientists believe that global warming could result in some local cooling points in the Pacific Northwest rather than a universal warming effect (Smith 1990). If the climate cooled, it could place increasing importance on the southern parts of the range and on low elevation habitats. If the climate warmed, it could place increasing importance on the northern extent of the range.

Emphasis should be placed on management for clusters, or local population centers, of owls in large habitat blocks rather than for individual pairs.

Empirical evidence and modeling show that clusters of 15 to 20 breeding pairs have much higher persistence rates than small, isolated clusters. These clusters, or local population centers, can be defined as groups of breeding owls where pairs have overlapping or nearly overlapping territories. The evidence and rationale supporting this principle are described in detail in Thomas et al. (1990).

One of the advantages of local population clusters is that they can provide for a population structure that can sustain itself for many generations. This contrasts with extremely small local populations, composed of two or fewer pairs, that are highly susceptible to local extinction (Diamond 1984). In order to realize this advantage, the local populations must be large enough to hold multiple breeding pairs, and also support juveniles, subadults, and "floaters." Floaters are nonbreeding individuals without established territories. It is thought that they serve as ready replacements for birds that die or vacate their territories for other reasons (Thomas et al. 1990). This ready replacement of birds in breeding territories should help maintain the populations within the local population centers.

Within each local population center, it is critical to provide for stable or improving habitat conditions. This will reverse the trend of increasing fragmentation of habitat which has been experienced in most areas across the range. Fragmentation of habitat is associated with lowered spotted owl densities, decreased productivity of spotted owl populations (Bart and Forsman 1992), increasing susceptibility of forest stands to windthrow, decreasing success of juvenile dispersal, and possibly increased competition with barred owls and predation by great horned owls (Thomas et al. 1990).

For a strategy based on local populations to be successful, those local populations must be capable of acting as sources of surplus owls for the species' metapopulation. A source area is one that has a positive rate of population increase and is capable of contributing individuals to the metapopulation. Local populations might cease to act as sources if they are too small or if they occupy highly fragmented habitat (Thomas et al. 1990). It is important to note that each local population does not have to act as a source each year. It is expected that there will be some variation across populations and across years, and that a portion of the local populations would not act as sources in some

years. The strategy of managing for many local populations within the metapopulation should allow maintenance of a nondeclining trend in the metapopulation despite this variation.

The management for local populations within the metapopulation also should be designed to reduce the risk of local or widespread extirpation of owl populations due to catastrophic destruction of habitat. Such destruction could result from natural causes including windthrow, fire, flooding, insects, diseases, volcanic action, or climatic change. The risk to the overall population from large-scale disturbances is reduced by distributing local population centers across the species' range, and by providing redundancy of habitats. Additional security from catastrophic loss can be provided by reducing the risk within local population centers. The risk of catastrophic loss within a given population center can be influenced by the size, configuration, and management of that center. Larger areas are less susceptible to complete elimination from fire and windthrow. The likelihood of fire, and the likely impacts of fire, can be reduced through management of fuels both within the population center and in the surrounding forest matrix. In some ecological conditions, the risk of serious insect and disease losses may be reduced through appropriate management.

Habitat conditions and spacing between local populations must provide for survival and movement of northern spotted owls.

Metapopulations are sets of local populations that are linked by dispersing individuals. While each local population might be subject to extirpation over the long term, individuals dispersing among the areas help to reestablish local populations after severe local declines or extirpations. The interbreeding provided by dispersing individuals also provides insurance against deleterious effects of inbreeding. To allow for movement of northern spotted owls among source areas, those areas must be spaced appropriately; there must be redundant linkages among areas; and the intervening habitat must provide the dispersal needs of adults and juveniles.

Studies of dispersing juvenile owls (Miller 1989, Gutiérrez et al. 1985) indicate that their initial movements have a strong random component. The probability of a juvenile finding suitable habitat is related to the amount of suitable habitat in the landscape around its natal area and the distance of that habitat from its starting point. Increasing the number of blocks of suitable habitat within the dispersal distance of any given local population center will increase the chance for success of dispersing juveniles. Also, having each block within the dispersal distance of two or more other blocks allows the system of local population centers to retain connectivity even if a given local population is eliminated. In this case, that population center can be reoccupied by owls coming from two or more other centers.

The connecting zones among local population centers must contain habitat that will allow movement of juvenile and adult dispersers and provide for basic life needs during the dispersal period. Key elements for survival include roosting opportunities, protection from predators, and adequate foraging opportunities (Thomas et al. 1990).

3. Integration of Strategic and Biological Principles

The northern spotted owl has been placed at risk by management actions that have seriously depleted its habitat. The habitat conditions that would be best for support of an owl population would be similar to those that existed before timber harvesting began. However, recreating such habitat conditions would not be feasible. Efforts to restore habitat conditions in any part of the range would have large economic effects, and those economic consequences force difficult biological choices in the design of a recovery strategy. The strategy developed here places large blocks of habitat on federal land off-limits to regular timber harvesting and should provide a reasonable assurance of success of recovering the northern spotted owl. However, it required consideration of many compromises in conservation area size and spacing and the structure of intervening forests. Such compromises are inevitable in a strategy that calls for blocks of superior habitat distributed within a landscape of lower quality habitat. The situation for owls could be made more secure if favorable habitat conditions could be spread more evenly across the landscape. Such a solution might be possible if it can be demonstrated that silvicultural techniques can create and maintain suitable habitat conditions while harvesting timber. The Recovery Team supports the change over time toward such a solution when supported by appropriate data.

III.

C. The Recovery Plan

1. Overview

The recovery plan strategy is based on the principles stated in section III.B. The plan has three main components: establishing designated conservation areas (DCAs) on federal lands; managing the remaining federal land, referred to as the matrix; and encouraging contributions from nonfederal lands.

Federal Lands

The network of DCAs follows guidelines developed by Thomas et al. (1990). The DCAs provide for local population centers, or clusters, of reproductive pairs. It is anticipated that birth and survival rates in these clusters normally will equal or exceed death rates, allowing the clusters to serve as source areas for owls. The clusters are arranged across the federal landscape to meet, as nearly as possible, the principle that northern spotted owls should be recovered across their entire range and the full variety of ecological conditions within that range.

DCAs will be managed to improve owl habitat. Thinning and other silvicultural practices will be used to accelerate development of suitable habitat in areas that are currently unsuitable. Such management, however, will be used only where existing and new studies and data indicate that the development of suitable conditions could be accelerated. Salvage of dead trees in stands affected by large-scale disturbances also may take place, but only where that salvage will have a positive or neutral effect on owl habitat. Additional management activities are recommended in DCAs where there is significant risk of large-scale habitat destruction by fire, wind, insects, or disease. Detailed guidelines for management in DCAs are in section III.C.2.

Outside the DCAs, it is recommended that federal forestlands be managed to allow dispersal of owls among DCAs. These forests are called the matrix, following the terminology established by Thomas et al. (1990). Dispersal of owls among DCAs is important to replace owls that die and to avoid loss of genetic diversity. This is important under normal circumstances, when individual owls die, and unusual circumstances, when there is large-scale disruption of the population.

Federal matrix lands also will provide habitat to supplement DCAs in areas where existing conditions preclude achievement of the goals for size and spacing of DCAs. These areas of additional habitat are called reserved pair areas. Specific criteria were used to determine where they should be delineated (section III.C.2.).

In the eastern Washington Cascades, large-scale habitat disturbances are likely, due to fire and insect outbreaks. These disturbances are a significant threat to the sparse spotted owl population in that area. To reduce the risk, the plan recommends providing habitat for additional owl pairs and territorial single owls outside of DCAs. The plan also recommends managing these areas to reduce risk of fire and insect damage.

Finally, the plan recommends maintaining residual habitat areas around existing owl pairs and territorial singles. These small areas will help maintain options to provide for owls throughout the landscape in the future.

A broader array of management practices will be used in the matrix than in the DCAs. The timing and location of management practices will be designed to achieve desired conditions through time. Details of matrix management are in section III.C.2.

Nonfederal Lands

In many areas throughout the owl's range, federal lands are not adequate to provide recovery. In these areas, nonfederal actions are needed. Currently, primary nonfederal action is providing habitat for existing owl pairs to avoid take of those owls as defined by the Endangered Species Act. A variety of nonfederal contributions is envisioned in this plan (section III.C.4), and many contributions may be made in lieu of take provisions. These actions are termed protective management and may include: 1) helping to meet objectives for DCAs where nonfederal lands are mixed with federal lands; 2) providing for clusters of breeding pairs on nonfederal lands; 3) providing habitat for individual owl pairs; and 4) providing dispersal habitat.

Evolution of the Strategy

The recovery strategy should evolve as more information is collected on owls and their habitat. The monitoring and research program is designed to provide that information. The recovery plan recommends establishing an interagency group to coordinate this gradual refinement and modification of the recovery plan strategy, and it recommends maintaining the Recovery Team to fulfill this function until such a group is established.

Organization of This Chapter

All facets of the proposed recovery plan are discussed in the following sections. Section III.C.2. reviews management on federal lands. It discusses the delineation of DCAs; criteria used to determine where matrix prescriptions should be applied; and specific management recommendations for the DCAs and the matrix. Section III.C.3. discusses implementation strategies and tools for federal and nonfederal lands, and a proposed implementation schedule. Section III.C.4. presents a comprehensive discussion of recovery goals for all lands in each physiographic province. It also describes how those goals might be implemented on nonfederal lands. Section III.C.5. describes coordination efforts that will be needed to make the recovery plan successful. Section III.C.6. outlines the monitoring and research program that will be needed to improve the plan over time and to provide information for delisting.

III.

C.

2. Management Guidelines for Federal Lands

Designated Conservation Areas

Delineation of DCAs

The DCAs recommended on federal lands in this plan were derived from the habitat conservation areas (HCAs) proposed by Thomas et al. (1990). The objective of the original HCA network was to establish habitat areas large enough to support 20 pairs of owls with contiguous or nearly contiguous home ranges. The 20-pair goal was based on empirical evidence and on simulation modeling which showed that clusters of 20 interacting pairs were likely to persist for at least 100 years. These areas were to be spaced a maximum of 12 miles apart, edge-to-edge. The spacing guideline was developed to ensure that juvenile owls, dispersing from their birthplace, would be able to find suitable habitat for nesting. Two-thirds of the juvenile owls studied at the time of the ISC report had moved at least 12 miles. HCAs were as circular as possible to minimize the perimeter-to-area ratio.

The 20-pair HCAs were termed category 1 HCAs. Where 20-pair areas could not be established, Thomas et al. (1990) recommended smaller areas capable of supporting two to 19 pairs. These smaller areas were termed category 2 HCAs. The draft recovery plan adopts this convention for category 1 and category 2 DCAs. However, some of the category 2 DCAs have the capability of supporting only a single pair of owls.

Thomas et al. (1990) used median annual home range size and density information to determine the appropriate size for the category 1 HCAs. HCAs were delineated to include the best available habitat and greatest number of known pairs or territorial singles. This process was done iteratively to achieve the best combination of habitat, known owls, and HCA shape. Where category 2 HCAs were delineated because there was no opportunity to create category 1 HCAs, these smaller areas were spaced at a maximum distance of 7 miles. Approximately 80 percent of juveniles that have been studied with radio transmitters have traveled at least this far (Thomas et al. 1990).

The HCA network was modified slightly in the draft recovery plan using updated inventories of owls and habitat (see Appendix I). Size and spacing criteria were not changed. Boundaries were altered to improve the biological and/or economic efficiency of the system. The resulting DCAs are summarized in Tables J.1 through J.11 in Appendix J.

There were 196 DCAs identified for the DCA network, with 56 satisfying the criteria for category 1 status. The remaining 140 areas are category 2 DCAs. To determine which DCAs met the criteria for category 1 status, the future capability of a DCA to support owl pairs on federal lands in the DCA was calculated. This figure was determined by assuming that 80 percent of the land within the DCA would become suitable owl habitat over time. The actual calculation is explained in Appendix J. In a few cases, where federal lands could support more than 15 pairs but not 20 pairs, the presence of existing owl pairs on nonfederal lands provided the basis for accepting DCAs as category 1.

A total of 1,181 pairs of owls has been located on federal lands in these DCAs within the last 5 years. This represents 48 percent of the 2,460 pairs of owls located on all federal lands during that period. The percent of owls included in DCAs by state is 81 percent in Washington, 39 percent in Oregon, and 54 percent in California. Differing percentages among the states result from the differences in current population levels and distribution of owls. The DCAs contain approximately 7.5 million acres of federal land including approximately 3.5 million acres of nesting, roosting, and foraging (NRF) habitat. This represents about 48 percent of all NRF habitat on federal land. The percent of habitat included in DCAs by state is 55 percent in Washington, 44 percent in Oregon, and 43 percent in California. A summary of the DCA network is presented in Figures 3.1 and 3.6. The DCA network is illustrated on the maps included with the recovery plan, and it is discussed further in section III.C.4. Additional pairs of owls on federal lands will be protected by matrix management prescriptions. See sections III.C.2. and III.C.4.

Management of DCAs

Effective management of the DCAs is necessary to achieve recovery. This section describes the management guidelines that will govern activities on federal lands in DCAs. These guidelines apply to the owl's entire range. They must be refined and use province-specific information before they can be applied to projects. It is recommended that interagency groups be established to develop this province-specific guidance. Implementation of the guidelines will be accomplished by preparing management plans for individual DCAs. The recommended components for DCA management plans are described briefly in this section and in more detail in Appendix E.

The DCA management guidelines have several key objectives. First, they allow natural successional processes to continue operating in areas of currently suitable habitat. They focus silvicultural activities within DCAs on developing suitable habitat conditions for owls where those conditions now do not exist. Another objective is to maintain or reestablish suitable conditions in areas being considered for salvage operations. Finally, maintaining currently suitable habitat conditions is an important consideration in areas where there is significant threat of large-scale disturbances (i.e., mixed conifer forests in the eastern Cascades). Some forest management activities which meet these objectives also may yield commercial wood products, but such products should not be part of the programmed timber harvest. In addition, the DCA management planning process will allow other ongoing activities to continue within DCAs where they are compatible with owl recovery.

The recovery plan recommends the preparation and approval of a management plan for each DCA before design and implementation of habitat manipulation activities. Land management agencies may choose to develop these plans as components of legally mandated plans (e.g., forest or resource management plans), or as stand-alone plans. Agencies are strongly encouraged to develop province-based planning guidelines as a basis for preparing plans. DCA management plans will serve as overview documents that provide a framework for carrying out specific activities. Individual plans should include: 1) a history and inventory of overall owl and habitat condition; 2) a description of other resources and land uses; and 3) criteria for determining appropriate treatments for specific owl needs and on-the-ground conditions within the DCA, consistent with the recommendations in this section and other applicable guidance. Individual DCA plans should contain oversight, monitoring, and evaluation components to help assure that activities are carried out as intended and achieve desired results. Interdisciplinary teams that include wildlife biologists, silviculturists, forest ecologists, fire scientists, forest ento-

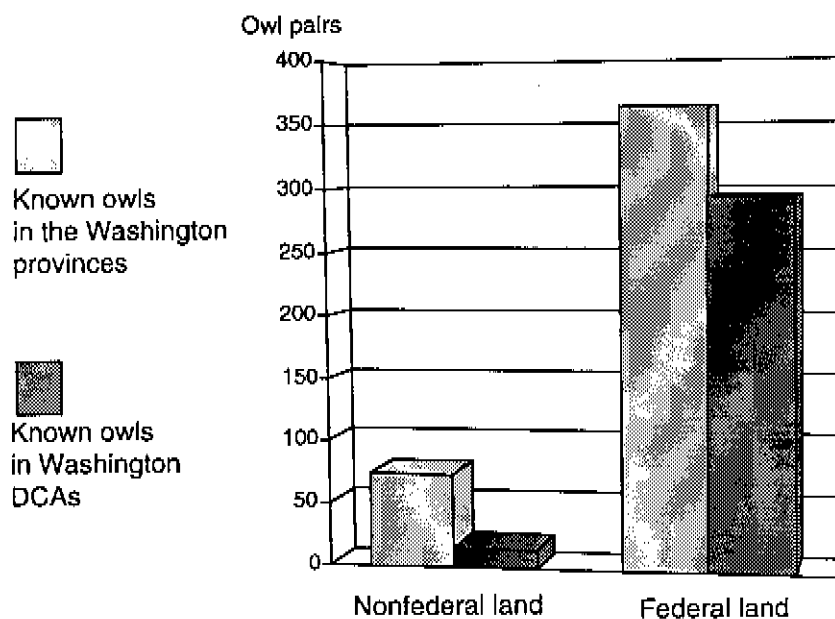


Figure 3.1. Total known owl pairs in the Washington provinces and in DCAs within the provinces.

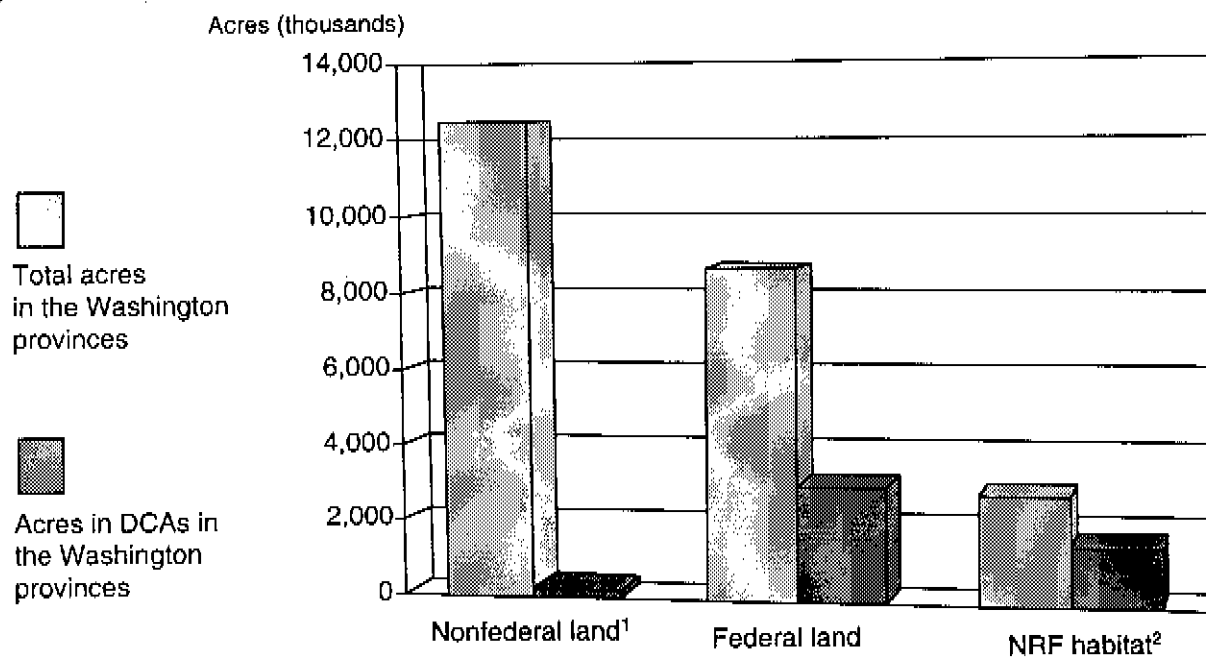


Figure 3.2. Acres in the Washington provinces and in DCAs within the provinces.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

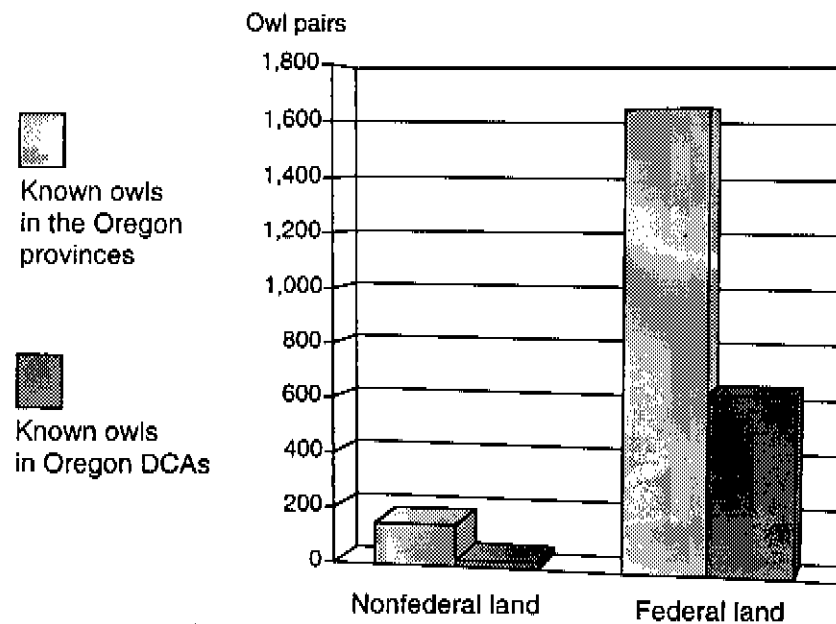


Figure 3.3. Total known owl pairs in the Oregon provinces and in DCAs within the provinces.

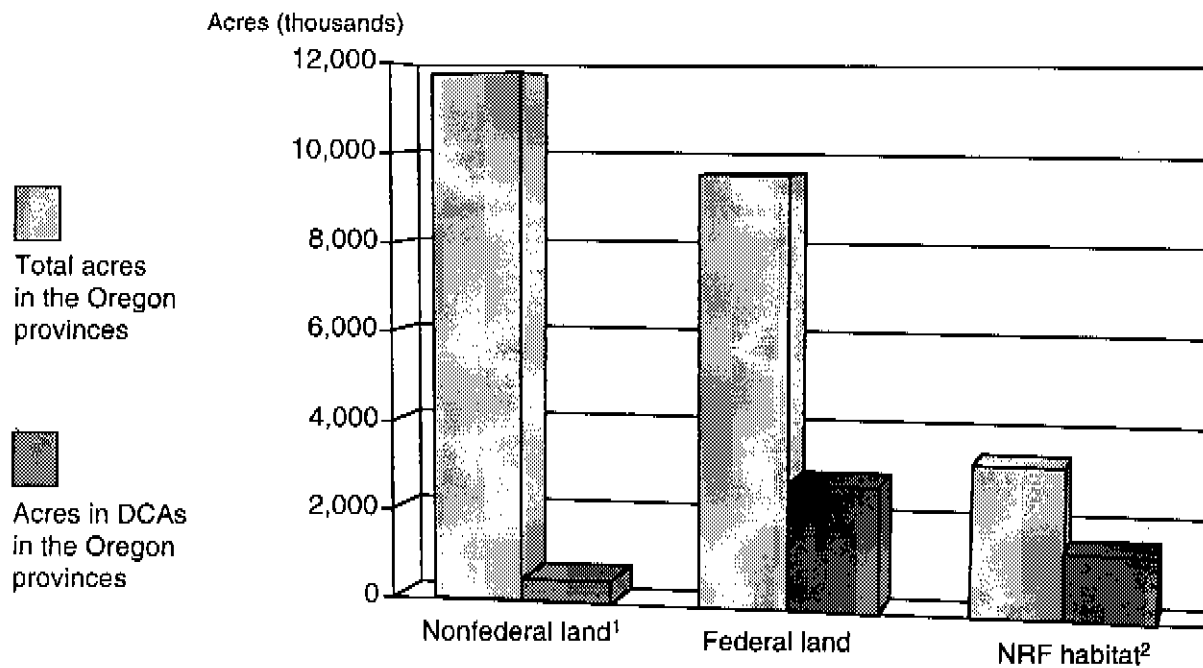


Figure 3.4. Acres in the Oregon provinces and in DCAs within the provinces.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

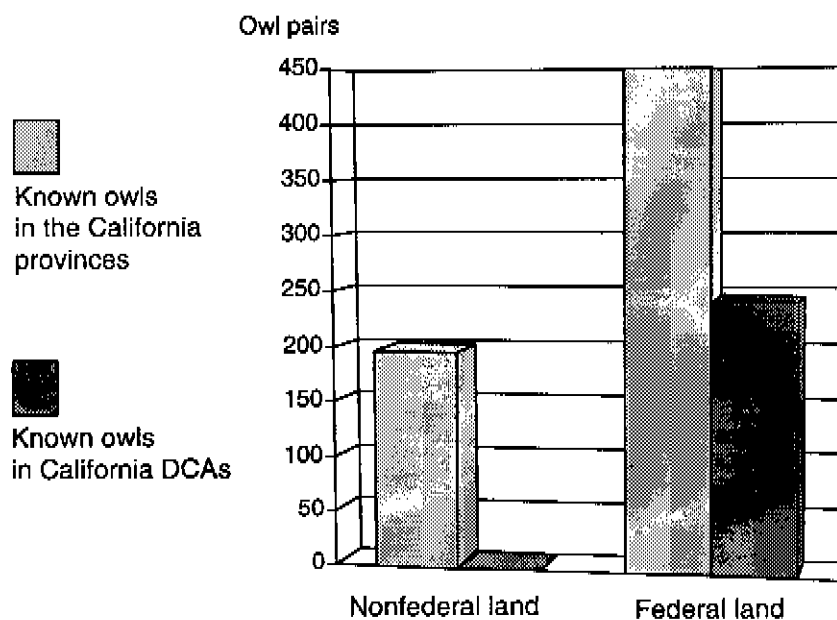


Figure 3.5. Total known owl pairs in the California provinces and in DCAs within the provinces.

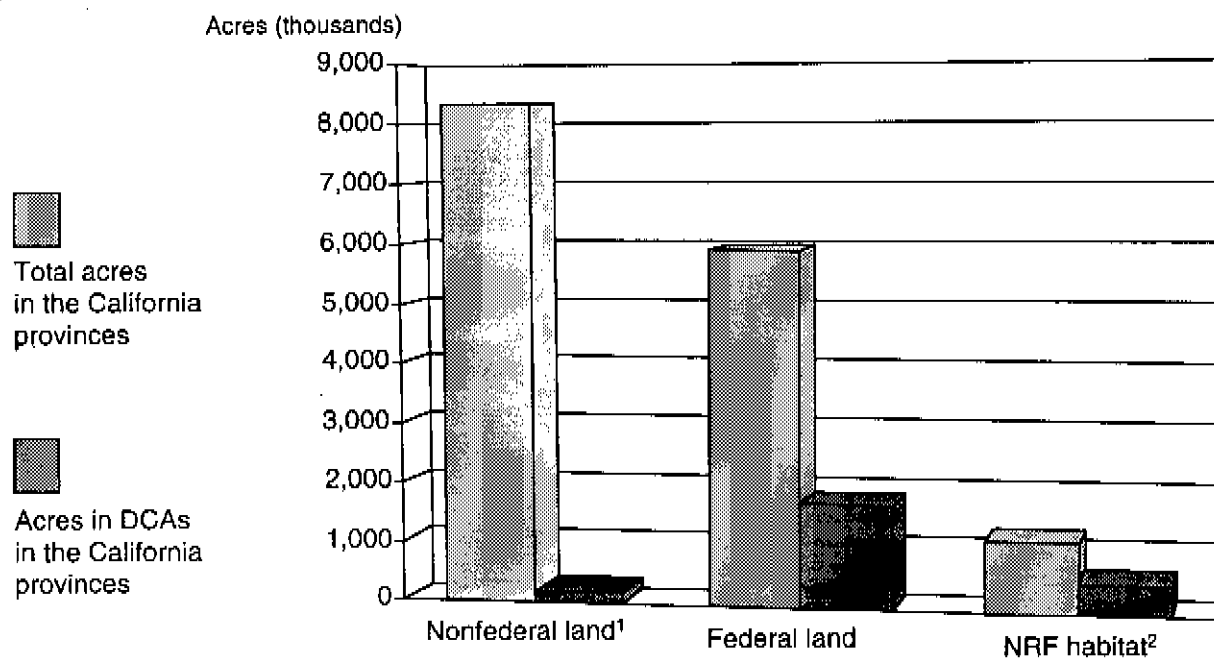


Figure 3.6. Acres in the California provinces and in DCAs within the provinces.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

mologists, and representatives of other appropriate disciplines should write the individual DCA plans, and be involved in oversight actions after implementation. More detailed guidance for DCA management plan preparation is in Appendix E.

The recommended DCA management guidelines and planning process are compatible with federal agency mandates and management frameworks. Since the recovery plan recommends that DCAs on certain federal lands be designated as critical habitat (see section III.C.3), the guidelines should be used by the FWS as the basis for adverse modification determinations for those lands under section 7 of the Endangered Species Act. Accordingly, after a DCA management plan is prepared by a federal land management agency, submitted for formal consultation, and approved by the FWS, it is expected that proposed activities would proceed. Agencies must provide for plan revisions within reasonable time frames (e.g., the normal agency planning cycle) to incorporate new information and in cases involving major disturbances (e.g., a significant fire). In the interim period after agency implementation of the recovery plan but before the preparation of individual DCA management plans, any proposed activity must be submitted for consultation on a case-by-case basis. Finally, since the guidelines apply to federal lands in DCAs, management planning in areas of mixed ownership will necessitate approaches that are tailored to the specific situations involved. For example, interagency coordination will be needed to ensure effective monitoring and to manage risks of large-scale disturbances. In addition, coordinated planning will help ensure that maximum benefit is derived from the contributions by all landowners.

Guidelines for Silviculture. The primary objective of silvicultural activities in DCAs is to improve habitat in stands with currently unsuitable conditions. Consequently, activities are encouraged if empirical information and modeling provide a high level of confidence that the development of suitable habitat conditions will be accelerated. Specific examples of appropriate silvicultural activities are in Appendix G. General guidelines for silvicultural activities follow.

1. To safeguard the conservation benefits of DCAs, silvicultural activities should be directed at stand types that owls consistently avoid, as documented in habitat selection studies. Accordingly, activities should be directed at stands that: 1) are even-sized with an average diameter (tree of average basal area) of 11 inches dbh or less, excluding large trees from the previous stand, if any; 2) show no significant development of a multiple-canopy tree structure; and 3) were regenerated following previous harvest activity. Activities in other types of stands can be considered on a case-by-case basis, particularly where those stands are stocked heavily and not being used by owls. Examples may include stands that were planted following catastrophic fires or stands previously dominated by conifers that converted to hardwoods following harvest. Well-documented justification is required before such activities would be allowed.
2. Activities must maintain or reduce risk of large-scale natural disturbance. For example, activities would not be implemented if they significantly increase the risk of windthrow in a stand.
3. To promote habitat suitability, thinning operations will leave some trees as snags and others as down wood. In addition, some trees may be removed for commercial or fuel hazard reasons.
4. Key attributes of forests inhabited by the northern spotted owl are their diversity and variability on individual sites and from site to site. To promote diversity and variability, a wide range of silvicultural practices will be applied, as opposed to reliance on a limited variety of techniques.

5. Activities that comply with these guidelines should provide positive recovery benefits as demonstrated in Appendix G. Actual implementation experience, however, is not extensive. A modest rate of implementation is prudent and will provide the opportunity to assess and refine activities. Acreage to be manipulated by silvicultural activities will be limited to 5 percent of the total area in any DCA within the initial 5-year period of the recovery plan, unless actions concerning large-scale disturbances (as described later) explicitly are justified.
6. Some habitat modification activities in DCAs will generate enough revenue to pay for themselves. Others will not and need to be supported by appropriated funds. Since the purpose of silvicultural activities in DCAs is to advance recovery, it is not appropriate to conduct only activities that generate a commercial return and ignore the needs of stands that cannot be treated commercially. A balance will be maintained between activities in young stands that produce no commercial return and in somewhat older stands that have the potential to produce commercial products.
7. Owl habitat needs increasingly are well defined. However, all species do not derive comparable benefits through actions designed to improve owl habitat. To the extent feasible, habitat requirements of other listed or candidate species also will be considered in planning silvicultural activities.

Guidelines for Salvage. "Salvage" is defined as the removal of trees from an area following a stand-replacing event which may result from wind, fire, insect infestation, or disease. In certain circumstances, salvage operations in DCAs may be compatible with recovery objectives while providing removal of merchantable wood. For example, salvage could help promote regeneration where excessive amounts of coarse woody debris interfere with seedling growth. However, it is important to recognize that tree mortality is a natural process within a forest ecosystem. Dead, diseased, and damaged trees are key components of stand structure and assist in meeting owl needs. Accordingly, to provide development of suitable owl habitat, DCA management planning must acknowledge the considerable value of leaving dead trees in the forest as well as the benefits from salvage activities. General guidelines for salvage follow.

1. The potential for benefit from salvage is greatest when stand-replacing events are involved. Salvage in disturbed sites of less than 10 acres is not appropriate because small forest openings are an important component of old-growth forests. In addition, salvage will occur only in stands in which disturbance has reduced canopy closure to less than 40 percent, as stands with more closure are likely to provide dispersal habitat for owls.
2. Surviving trees will provide a significant residual of larger trees in the developing stand. In addition, defects caused by fire in trees may accelerate development of structural characteristics suitable for owls. Also, those trees which eventually die will provide additional snags. Consequently, standing live trees will be retained, including those scorched but likely to survive. Inspection of the cambium layer can provide an indication of potential tree mortality. All trees that may live should be retained.
3. Snags provide a variety of habitat benefits for owls. Accordingly, where disturbance events leave snags, management will focus on retaining all snags likely to persist for 100 years. During this period, the stand does not otherwise contribute significant quantities of large diameter snags or down logs. Snags from the original stand may be an important component of flying squirrel habitat as forests develop after fire. Although there is some uncertainty concerning the optimum density of snags to be provided for squirrels, management to provide maximum benefit likely for

this prey species is an appropriate strategy for DCAs. Therefore, snags larger than 20-inch dbh will be retained.

This guideline may need to be refined for application in some physiographic provinces. However, retention of all stems larger than 20-inch dbh is likely to provide the highest probability of long-term retention of snags throughout the owl's range. Management planning in areas such as northern California may require specific guidance for hardwood snag retention, and to provide habitat for woodrats, a prey species. In all areas, however, the primary focus should be on long-term planning.

4. Coarse woody debris (CWD) biomass (i.e., snags and down logs) provides habitat for organisms that are important food of several owl prey species, as well as having other habitat-enhancing characteristics. In the first 100 years after a stand-replacing disturbance, the amount of CWD added by the new stand is not significant, so retaining remnant CWD from the previous stand during this time is important. Following a stand-replacing disturbance, management will provide for CWD quantities in the new stand which, after 100 years, would be similar to amounts in naturally regenerated stands at that age. As in the case of snags, province-level specifications must be provided for this guideline. Since decay rates and biomass naturally remaining at 100 years undoubtedly will vary among provinces and forest types, the specifications also will vary.
5. Some salvage that does not meet the preceding guidelines will be allowed when salvage is essential to reduce the risk of fire or insect damage to suitable owl habitat. This circumstance is most likely to occur in the eastern Oregon and eastern Washington Cascades and California Cascades provinces, and somewhat less likely in the Oregon and California Klamath provinces. It is important to understand that some risk associated with fire and insects is acceptable because they are natural forces influencing forest development where owls occur. Consequently, salvage to reduce such risks should be minimal, and considered as an exceptional practice.
6. Small-scale removal of snags and logs may be necessary to reduce hazards to humans along roads and trails and in or adjacent to campgrounds. Where materials must be removed from the site, as in a campground, a salvage sale is appropriate. In other areas, such as along roads, leaving material on site should be considered. Also, material will be left where available CWD is inadequate.
7. Where green trees, snags, and logs are present following disturbance, the above green tree and snag guidelines (discussed earlier in this section) will be applied first, and completely satisfied where possible. The biomass left in snags can be credited toward the amount of CWD biomass needed to achieve management objectives.
8. Since remnant CWD may be relatively small after disturbances in younger stands, diameter and biomass retention guidelines should be consistent with silvicultural programs designed to regenerate suitable owl habitat.
9. Logs present on the forest floor before a disturbance event provide habitat benefits which are likely to continue. It seldom will be appropriate to remove them. In addition, these logs will not be credited toward objectives for CWD retention developed after a disturbance event.
10. The CWD retained will approximate the species composition of the original stand, to help replicate preexisting suitable habitat conditions.

The following section contains an example of the application of salvage guidelines in the Douglas-fir/Western Hemlock Zone of the western Oregon and Washington Cascades. The example shows how specific guidelines would be developed for an area where an old-growth forest stand suffered catastrophic disturbance.

Applying Salvage Guidelines in Western Washington and Oregon

This example is developed for salvage of a hypothetical stand that suffered a stand-replacing fire. Prior to the fire, the stand would have been classified as old-growth. Live tree densities for the original stand are in Table 3.1

Snag Retention

Snag decomposition rates are related inversely to diameter. Equations developed by McComb and Ohmann (pers. comm.) predict that in western Washington and Oregon the probability of snags less than 20-inch dbh persisting for 100 years is near zero. Above this diameter, probabilities of snag survival increase rapidly for western hemlock and Douglas-fir.

Snags more than 20-inch dbh are especially important for cavity-nesting birds. Nelson (1989) found significant selection by cavity-nesters for snags of this size. Smaller snags were not selected. Carey et al. (1991) and Lundquist and Mariani (1991) also found greater use of larger snags. Since flying squirrels, an owl prey species, are secondary cavity users, management for higher densities of primary cavity-nesters will benefit squirrels and, indirectly, owls. Retention of all snags more than 20-inch dbh will maximize the number of residual snags available to flying squirrels, while providing important habitat for bird species responsible for the excavation of cavities used by squirrels.

Application of the guidelines for salvage to an old-growth forest in the Oregon Cascades will provide retention of an average of 17 Douglas-fir and 9 hemlock snags per acre based on mean live-tree densities (Table 3.1) for those forests (Spies pers. comm.). Because of the diversity of initial diameters, predicting snag population survivorship is complex. However, projections based on decay rate constants of Harmon et al. (1986) suggest that about two Douglas-fir snags per acre will remain in 100 years. The equations of McComb and Ohmann (pers. comm.) predict that as many as four to six Douglas-fir and one hemlock snags per acre may persist. These estimates are within the range of densities commonly found in naturally regenerated stands at that age (Carey et al. 1991, Huff et al. 1991, Spies and Franklin 1991).

Table 3.1. Live tree densities in example old-growth western hemlock/Douglas-fir stand prior to stand-replacing fire.

	Stem Density per Acre by Size Class				
	2 to 4 inches	4 to 20 inches	20 to 40 inches	40 to 60 inches	60 inches+
Douglas-fir	10	17	8	7	2
Western hemlock	23	33	8	1	0

After 100 years residual snags will be well decayed and about half will be more than 15 feet tall (Spies and Franklin 1991). Not all snags will have cavities for flying squirrels. In mature forests (80 to 195 years old) in western Oregon and Washington, an average of 8 percent of snags more than 20-inch dbh contained natural cavities and 24 percent had excavated cavities (Spies and Franklin 1991). Even if natural and excavated cavities were in different snags, only about 30 percent of all snags would have cavities, and post-fire retention of all snags more than 20-inch dbh may only provide one or two residual snags per acre with cavities. It is prudent initially to retain maximum numbers of large snags to provide for long-term needs of cavity-nesters, including flying squirrels.

In this scenario, approximately 17 Douglas-fir and 44 hemlock stems per acre between 4- and 20-inch dbh would be available for salvage. The volume probably would be similar to that removed during commercial thinning. Application of the snag guideline provides for maximum densities of snags at 100 years, while allowing removal of smaller diameter stems which would not persist.

Log Retention

In the western Oregon Cascades and Oregon Coast Range, most naturally regenerated conifer forests contain 9 to 18 tons per acre of down logs at 100 years of age (Spies et al. 1988). Assuming a 3 percent annual decay rate (Spies et al. 1988) for 100 years, about 180 tons per acre of CWD need to be retained to provide this quantity. Therefore, approximately 50 to 75 percent of the original standing biomass of 270 to 360 tons per acre (Spies et al. 1988) must remain on the site. Down logs with diameters greater than 20 inches should be retained selectively. These larger logs will decay relatively slowly and provide habitat for forest floor mammals during a relatively long time period (Carey and Raphael pers. comm.).

If regeneration is delayed, significantly greater amounts of CWD must be retained to compensate for delaying CWD production by the new stand 100 years hence. Thus, when areas are salvaged, it is extremely important to regenerate new stands as quickly as possible.

If green trees, snags, and logs are on site following the disturbance, guidelines to retain all green trees and all snags with diameters greater than 20 inches will be applied first. The guideline for logs will reflect the amount of biomass left in the form of snags since this standing material eventually will become available as CWD. For example, if snags were estimated to provide 90 tons per acre, this amount will be deducted from the 180 tons per acre required to be left as logs.

In any case, where the combined biomass of snags and logs greater than 20 inches in diameter do not meet retention objectives (e.g., 180 tons per acre in western Oregon and Washington Cascades), additional logs and/or snags of smaller diameter will be retained.

Guidelines to Reduce Risks of Large-Scale Disturbance. Large-scale disturbances are natural events, such as fire, that can eliminate owl habitat on hundreds or thousands of acres. Certain risk management activities, if properly planned and implemented, may reduce the probability of these major stand-replacing events. There is considerable risk of such events in DCAs in the eastern Oregon and eastern Washington Cascades and the California Cascades provinces and a lesser risk in the Oregon and California Klamath provinces (as documented in Appendix F). Elevated risk levels are attributed to

changes in the characteristics and distribution of the mixed conifer forests resulting from fire protection. These forests have had repeated insect infestations and are susceptible to major fires. Risk reduction efforts are encouraged where they are consistent with the overall recommendations in this section.

Silvicultural efforts will focus on currently unsuitable habitat in DCAs to accelerate development of suitable conditions for owls while making the future stand less susceptible to natural disturbances. Salvage activities will focus on the reduction of insect, disease, and fire threats. Treatments will be designed to provide effective fuel breaks wherever possible. However, the scale of salvage and other treatments must not result in erosion of currently suitable owl habitat.

Guidelines for Coordination of Other Multiple-Use Activities. A variety of activities currently occur in DCAs or may be proposed in the future. The highest priority of DCA management is to meet owl needs and promote recovery, and all activities will be evaluated in that regard. The type and extent of multiple-use activities will vary among DCAs, and will be reflected in DCA management plans. It will be necessary to modify or eliminate activities that pose adverse impacts, and impose seasonal or other appropriate restrictions on some other proposed actions. This may require the revision of management guidelines, procedures, or regulations governing these multiple-use activities.

Assessment of all multiple-use activities within one-quarter mile of the known owl activity centers, to determine their effects on owl reproductive success, will be included in DCA management plans. Between March 1 and September 1 of each year, activities which may disrupt owl breeding will be prohibited under the management plan.

The following guidelines address activities most likely to require attention in DCA management plans.

1. **Road Construction and Maintenance.** Transportation needs must be assessed for the DCA itself and for adjacent areas. The assessment should consider all existing and planned activities within the DCA. Access to nonfederal lands through DCAs will be considered and existing rights-of-way agreements must be recognized as valid existing rights. A determination will be made if existing roads are needed or if closure and rehabilitation is appropriate. Future needs of road access for fire protection must be considered when identifying roads for closure and rehabilitation.

Road construction in DCAs for silvicultural, salvage, and other activities generally is not recommended, unless potential owl habitat benefits clearly exceed potential costs of habitat impairment. If new roads are necessary to execute a practice that is otherwise in accordance with these guidelines and an approved DCA management plan, they will be kept to a minimum, be of a temporary nature, be of the lowest standard possible to accomplish the intended purpose, and be routed through unsuitable habitat where possible. Where economically feasible, aerial logging systems will be used instead of new road construction.

New road construction through DCAs may be necessary to access nonfederal lands. In these cases, alternate routes that avoid the DCA should be considered. If roads must be routed through a DCA, they will be designed and located to have the least impact on owls and owl habitat. New roads will not be constructed through suitable owl habitat unless no other feasible alternatives exist.

2. **Fuelwood Gathering.** If allowed, fuelwood gathering will be restricted to existing cull decks, blowdown blocking roads, or green trees marked by silviculturists to thin overstocked unsuitable habitat. These areas will be mapped during preparation of the DCA management plan and mitigation recommendations will be included.
3. **Mining.** The impacts of proposed mining actions should be assessed, and mineral activity permits will include appropriate conditions (e.g., seasonal or other restrictions) related to all phases of mineral activity.
4. **Developments.** In general, construction or development of new facilities that may adversely affect owl habitat or reproductive success will not occur within DCAs. Proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, or other public works projects, will be reviewed on a case-by-case basis and may be approved when adverse effects can be minimized and mitigated. Whenever possible, such projects should be anticipated and addressed in DCA management plans.
5. **Trail Development.** New trail construction will be planned to have the least possible adverse effect on owls. Trails will be located at least one-quarter mile from owl activity centers and otherwise avoid adverse modification of suitable owl habitat.
6. **Land Exchanges.** Land exchanges in DCAs will be considered when they will either promote owl recovery or provide owl benefits equal to current conditions at a lower cost.
7. **Habitat Improvement Projects.** Projects designed to improve conditions for fish, wildlife, watershed, range, or recreation will be considered if they provide owl habitat benefits or enhance the likelihood of reproductive success. Other projects will be considered if their effect on owls or owl habitat is negligible. These may include small projects required for recovery of other threatened or endangered species. In all cases, appropriate project management will be provided. For example, watershed rehabilitation projects, such as felling trees along streams, will be coordinated with a wildlife biologist and include seasonal restrictions.
8. **Range Facilities.** Range-related facilities that do not affect owls or owl habitat adversely will be developed in coordination with wildlife biologists. Existing grazing activities which have an adverse effect on owl habitat or owl use of the area will be modified.
9. **Fire Suppression and Prevention.** Fuels management within the DCA will be in accordance with guidelines for reducing risks of large-scale disturbances. Plans for wildfire suppression will emphasize maintaining owl habitat within the DCA. During actual fire suppression activities, a resource specialist familiar with the area and the DCA management plan will be included to assure that habitat damage is minimized.
10. **Christmas Tree Sales.** Christmas tree sales will be allowed in areas where trees are removed in accordance with the objective of accelerating the development of suitable habitat conditions in areas that currently are unsuitable. The guidelines for silvicultural activities will be used as appropriate.
11. **Minor Forest Products.** Minor commercial uses, such as the collection of ferns, mosses, and mushrooms, generally will be allowed. Where these activities are extensive (e.g., collection of Pacific yew bark), it will be

appropriate to evaluate whether they have significant effects on owl habitat. Restrictions may be appropriate in some cases.

12. **Recreational Uses.** Dispersed recreational uses, including hunting, generally are consistent with the objectives of DCAs, except as specifically noted elsewhere in the draft recovery plan.
13. **Research.** A variety of wildlife and other research activities (e.g., water quality) may be proposed in DCAs. These activities must be assessed to determine if they are consistent with DCA management guidelines. If agencies address the range of these activities explicitly in DCA management plans, disruption of existing research or disincentives for proposed research may be avoided, particularly in the case of small and widely dispersed experimental forestlands.
14. **Rights-of-Way, Contracted Rights, Easements.** Existing and proposed agreements will be evaluated and revised where feasible. In some cases, preexisting agreements may pose legal issues or raise other concerns that require consideration in the DCA management plan.

b. Other Federal Lands

For the purposes of the recovery plan, the "matrix" is defined as lands within the range of northern spotted owls which are outside DCAs. This discussion is specific to federal matrix lands. Recovery contributions from nonfederal matrix lands are described in section III.C.4.

Federal matrix lands will make several essential contributions to recovery. Their most basic function is to help maintain adequate habitat conditions to allow movement of owls among DCAs. As described in section III.B., this interchange among DCAs is necessary to allow functioning of the whole spotted owl population. The second function of the matrix is to maintain reproductive owl pairs, where possible, in areas where DCAs cannot fully meet the criteria (section III.C.2) established by the recovery plan. These pairs will help supplement DCAs where owl populations or habitat are deficient until those deficiencies can be corrected. In some cases, population deficiencies in DCAs may not be corrected for a long period of time and owl pairs in the matrix will remain a part of the recovery strategy for the foreseeable future. In other areas, the matrix will be required to support pairs of breeding owls as a safeguard against the possibility of large-scale loss of habitat in DCAs from fire, insects, and disease. Finally, the matrix will contain areas of nesting habitat that will preserve options to reestablish owls throughout the landscape.

Since habitat conditions and owl populations vary across the range, specific objectives for matrix forests also will vary. Four matrix management prescriptions have been identified. Criteria were developed to determine where these prescriptions will be applied. Those criteria and the implementation guidelines are described in this section. The province narratives (section III.C.4) identify the locations where the prescriptions will be applied and the approximate acreages involved.

Recommendations for federal matrix management provide for a broader mix of activities than the recommendations for the DCAs. It is expected that a wide variety of commercial timber activities will occur within the matrix, with their timing and location designed to meet the conditions specified for the matrix. For several matrix management prescriptions, the acres on which habitat goals are met may shift through time. For other prescriptions, such as the reserved pair areas, tighter controls on activities are recommended.

The application of prescriptions A, B, and C is essential to achieve recovery. Prescription D is recommended as a supplement to prescription A and could speed recovery of the species while providing benefits to other species.

PRESCRIPTION A — MAINTAIN DISPERSAL HABITAT AND ACTIVITY CENTER

Management objective

Provide habitat to support dispersing owls and maintain residual habitat areas that protect activity centers for pairs and territorial singles in the matrix. The other matrix prescriptions are supplemental to this minimum requirement.

Discussion. The minimum role of the matrix is to provide habitat conditions adequate to assure at least short-term survival of a significant proportion of dispersing owls (see sections II.A. and III.B.) To achieve species recovery, the matrix must play this role. The matrix also must protect a given number of owl activity centers referred to as residual habitat areas. The size requirement for residual habitat areas is based on information about home ranges used during the breeding season. These areas will not meet long-term needs of owls. However, they will provide areas of high-quality habitat for dispersing owls, prevent the direct elimination of nesting areas, and provide cores of suitable habitat to preserve future options for managing owls in the matrix. Given the recovery objective to reestablish owls throughout the landscape, providing residual habitat areas is essential.

Criterion for applying prescription

Management to achieve these minimum matrix objectives will be practiced on federal lands throughout the range of the owl where forests are sufficiently productive to attain the conditions specified.

Management guidelines for prescription A

1. The number of residual habitat areas to be provided is based on densities of owl pairs observed in study areas. These target densities vary by province where appropriate (Table 3.2).

Table 3.2. Density of residual habitat areas

Physiographic Province	Areas Per Township
Olympic Peninsula	4
Western Washington Cascades	6
Eastern Washington Cascades	6
Western Oregon Cascades	8
Eastern Oregon Cascades	6
Oregon Coast Range	8
Klamath (Oregon and California)	10
California Coast Range	10
California Cascades	6

2. Residual habitat areas will be provided for all known and newly discovered pairs and territorial singles up to this density.
3. Each residual habitat area will include a minimum of 100 acres of suitable habitat as close to the nest site or activity center as possible. This is intended to preserve an intensively used portion of the breeding season home range. Timber management within this area is not appropriate. Management around the area will be designed to reduce the risks of natural and human-caused disturbance.
4. At least 50 percent of the federal forest matrix outside of the DCAs will be managed to provide stands of trees that average at least 11 inches dbh and have at least 40 percent canopy closure. This guideline will be applied on each quarter-township, and will be calculated based on the amount of federal land within that quarter-township. Calculation should be made separately for lands managed by each of the federal agencies. All forested land that is capable of attaining the 11-inch dbh standard and the 40 percent canopy closure standard will be included in the calculation. Hardwoods may be included in meeting the canopy closure guideline, but excluded from the diameter calculation where they normally do not attain that size. Canopy contribution will be counted only for evergreen hardwoods. There should be reasonable flying space under the hardwood canopy (i.e., 6 or more feet between the bottom of the hardwood canopy and the top of the shrub layer). Reserved pair areas (see matrix prescription B), managed pair areas (see matrix prescription C), and residual habitat areas may be included in the calculation.

In general, a stand meets the guideline if the tree of average basal area is at least 11 inches dbh and the total canopy closure is more than 40 percent. However, where there is much variation in dbh, the intent is that 40 percent canopy closure be contributed by trees which meet the 11-inch dbh standard.

PRESCRIPTION B — SUPPLEMENT DCA NETWORK

Management objective

Provide habitat (reserved pair areas) for pairs and territorial singles in the matrix to supplement the DCA network where the network is deficient because it fails to meet: 1) spacing criteria; 2) criteria for existing habitat acreage; and/or 3) criteria for either existing pairs or future pairs.

Discussion. Existing habitat and landownership conditions make it impossible to implement a fully adequate network of DCAs across the owl's entire range. At numerous locations the existing distribution of habitat and/or owls necessitated deviation from the size, spacing, or owl numbers criteria (section III.C.2). Where these deficiencies are significant, it is important to supplement the DCAs by maintaining additional suitable habitat and owl locations in the matrix. This reinforcement of the matrix population will improve stability of the owl population in the DCA and provide additional assurance of dispersal success across the matrix.

Criteria for applying prescription

Reserved pair areas will be established where any of the following conditions occur:

Category 1 DCAs contain less than 15 currently known pairs and territorial singles, or have a current expected capability to support fewer than 20 pairs of

owls. (Refer to tables in section III.C.4, for identification of these areas.) See management guidelines 1 and 2 (later in this section) for actions to be taken in these cases.

Category 1 DCAs are more than 12 miles apart, or category 2 DCAs are more than 7 miles apart. If category 2 DCAs are relatively large (i.e., 10 pairs), then it may be appropriate to modify this criterion to allow greater distances than 7 miles. See management guideline 3 for action to be taken in this case.

Other areas are identified on a case-by-case basis. These could include areas where 1) only small category 2 DCAs (i.e., two-pair areas) could be delineated or 2) where overall owl densities in the DCA network fail to meet densities that would be obtained if all guidelines (section III.C.2) for the DCA network were fully met. See management guideline 3 for action to be taken in this case.

Management guidelines for prescription B (assumes implementation of prescription A)

1. In areas where DCAs do not currently contain sufficient owl pairs and territorial singles, provide reserved pair areas for matrix pairs or territorial singles to increase to 15 the total known owl activity centers associated with a given category 1 DCA. The standard here is set at 15 known pairs or territorial singles rather than 20 because some pair sites in a DCA might not be occupied at any given point in time. This value was derived from a table of expected occupancy of areas given different numbers of interacting pair sites and different amounts of suitable habitat in the area (Voss and Noon pers. comm.).
2. Where category 1 DCAs contain inadequate suitable habitat to support at least 20 owl pairs, reserved pair areas will be established so that the total amount of habitat associated with a given category 1 DCA is adequate to support 20 owl pairs.
3. For areas that do not meet the distribution distance criterion, or other special emphasis areas, provide enough reserved pair areas so that the total pair density at least equals that which would be obtained if all guidelines for the DCA network were met. This density is two pairs per township.
4. To identify reserved pair areas, search for pairs and habitat that are as close as possible to the DCAs.
5. For each reserved pair area, delineate an area surrounding the activity center with an acreage at least equal to the median home range size for pairs. Use data from the study area that is most similar to the site being considered (Table 2.1). This area will be delineated to encompass as much suitable habitat as possible, and that habitat will be as close to the activity center as possible. Reserve all suitable habitat within that area from timber harvest. If this habitat acreage does not at least equal the median amount found for pairs in the province (Table 2.2), additional habitat must be provided from 1) the next best habitat available within the home range area, or 2) additional habitat outside the home range area.
6. Within these reserved pair areas, allow for management of currently unsuitable areas consistent with DCA management guidelines.
7. Wherever located, reserved pair areas will count toward the residual habitat area densities for prescription A. Residual habitat areas which are not required as reserved pair areas will continue to be managed under prescription A.

PRESCRIPTION C — REDUCE THREAT FROM DISTURBANCE

Management objective

In addition to the minimum requirements of prescription A, provide habitat (managed pair areas) for pairs and territorial singles in the matrix to supplement DCA populations in areas where there is significant threat of large-scale disturbance in DCAs.

Discussion. The probability of large-scale disturbances in DCAs in different provinces across the range of the owl was assessed by Agee and Edmonds (Appendix F). In the Oregon and California Klamath provinces and the eastern Cascades provinces of Oregon and Washington, there is significant probability of large-scale disturbances to the majority of DCAs due to insects, diseases, and fires.

Several factors help to compensate for this potential threat to the DCA network. First, design of the DCA network helps to buffer owl populations against catastrophic loss in any individual DCA. Second, as noted in section III.C.2. and Appendix F, some forms of active management (e.g., fuels management) may help to reduce the risk of large-scale disturbance within the DCAs. Finally, prescription C calls for innovative management to be used within the matrix to help provide for breeding owls in these managed forests. This will reduce the dependence of owl populations on the DCA habitat.

Criterion for applying prescription

For application of this prescription, an area must lie within high-risk portions of provinces identified by Agee and Edmonds (Appendix F) as having a low probability of long-term maintenance under a strategy where habitat is not managed but is protected from fire. This prescription will be applied immediately to the eastern Washington Cascades province because the spotted owl population in that province is at high risk from large-scale disturbance and is essential to support the overall owl population in Washington. Application of this prescription to the eastern Oregon Cascades, the California Cascades, and the Oregon and California Klamath provinces also should be considered but is not included as an immediate recommendation.

Management guidelines for prescription C (assumes the implementation of prescription A)

1. For all pair or territorial single activity centers identified under prescription A, provide additional suitable habitat in an area approximating the size of a pair home range surrounding the activity center.

The size of this area will be determined from median home range data for the province (Table 2.1). Use data from the study area that is most similar to the site being considered. The amount of suitable habitat within this area will approximate the median amount observed within pair home ranges for that same study area (Table 2.2).

2. This habitat may be maintained through time using various management techniques. Some uncertainty will be accepted in the use of management to provide habitat in these areas. Management will be designed to provide suitable habitat conditions and to alleviate the forest conditions leading to significant threat of large-scale disturbance. Refer to Appendix G for examples of management techniques useful in providing for suitable habitat conditions through time.

PRESCRIPTION D — RETAIN OWLS IN MANAGED LANDSCAPE

Management objective

In addition to the minimum requirement of prescription A, use a combination of silvicultural manipulations and habitat reserves to permanently support owl pairs and territorial singles. This is recommended in order to: 1) reduce the overall decline in population; 2) move toward total landscape management for owls; 3) provide opportunities to experiment with specific habitat management techniques, and 4) provide benefits for other species. While prescriptions A, B, and C are essential for recovery, prescription D is recommended to speed recovery but is not considered essential.

Discussion. The long-term goal of the recovery plan is to move from a landscape composed of protected areas and matrix toward a landscape where conditions provide for a more continuous distribution of owls. Unfortunately, many of the actions that might be taken in the short-term could impede rather than promote achievement of this goal. Effective pursuit of the goal requires three management commitments. First, some active forms of management in currently unsuitable younger stands within the DCAs should begin. Second, such techniques also should be applied in unsuitable habitat in the matrix to facilitate the development of suitable habitat in the matrix. Finally, there must be efforts to retain owls and suitable habitat in the matrix and to begin experimenting with active forms of management that will sustain habitat over time. Such management could include uneven-aged silviculture and management on long rotations. The latter two actions to support owls in the matrix will have a variety of benefits, including slowing the expected rate of overall owl population decline and possible benefits to other species (see Appendix D).

Application of this prescription may be particularly beneficial in several instances. It may be useful in areas where owls exist at relatively high densities well-distributed over the landscape. An example of such an area is the western Oregon Cascades province. Implementation of the DCA strategy in this province without additional measures in the matrix could result in a significant decline in the owl population. Such a decline would retard progress toward recovery.

Conversely, it may be beneficial to retain owls in the matrix in areas where the population outside DCAs is sparse. In such cases, removal of the few remaining owls from the matrix also seriously will impede the long-term goal to manage for owls across the landscape.

In addition, it would be useful to apply the prescription where it can benefit other species in the following categories:

1. Federally listed species or candidates for listing known to be associated with older forests.
2. Species with restricted ranges and associations with older forests where their ranges are not substantially included in existing DCAs.

Criterion for applying prescription

This prescription could be applied in any part of the matrix.

Management guidelines for prescription D (assumes the implementation of prescription A)

1. Provide managed pair areas in an area approximating the size of a pair home range surrounding the activity center. The size of this area and

amount of suitable habitat should be determined from home range data for study sites most similar to the site being considered (Tables 2.1 and 2.2). This habitat may be maintained through time using various management techniques. Some uncertainty will be accepted in the use of management to provide habitat in these areas. This habitat is not a requirement of recovery.

2. As an alternative, habitat may be provided and distributed throughout the matrix area rather than focused on owl activity centers. For example, the objective for matrix management could be to maintain 10 percent superior habitat and 20 percent marginal habitat (Thomas et al. 1990) in the matrix at all times. A combination of habitat retention and habitat management could be used to achieve the objective, with existing allocations contributing where they provide appropriate conditions. Under this alternative, residual habitat areas still would be a requirement. The acres in residual habitat areas will contribute to the total that is to be maintained as superior habitat.

III.

C.

3. Implementation

Federal lands

Federal agency planning.

Federal agencies should review the draft recovery plan to determine if it provides adequate assurance of recovery and can be implemented in an efficient manner. The Recovery Team will review agency comments on the draft plan and will work with the agencies to incorporate their comments in the final recovery plan.

The recovery plan was prepared under the assumption that agency activities submitted for consultation after January 1, 1993, will be consistent with its recommendations. Actions in areas of special concern should be made consistent with the recovery plan as soon as the final plan is approved. If agencies act inconsistently with the recovery plan for an extended period, reductions in owl populations and in the amount and quality of owl habitat could have results that were not anticipated during the plan's development. Such reductions might require a reevaluation of the recovery plan to determine whether it would still provide sufficient assurance of recovery.

After the final recovery plan is approved, federal agencies, the states, and the private sector will need advice and assistance on various aspects of implementation. The recovery plan recommends the establishment of a coordinating group to carry out these functions (see section III.C.5.). The group should be established upon approval of the final recovery plan or as soon thereafter as feasible. The Recovery Team should remain in existence to provide advice and necessary support until the coordinating group is established.

Implementation of the recovery plan will require that agencies with authority over forestlands comply with other legal mandates in addition to the Endangered Species Act. The BLM must implement the recovery plan in a manner consistent with the Federal Land Policy and Management Act (FLPMA) and National Environmental Policy Act (NEPA). The Forest Service must implement the plan in a manner consistent with the National Forest Management Act (NFMA) and NEPA. Full implementation of the recovery plan should be completed within 5 years. The anticipated schedule for implementation is outlined in section III.C.3.

Critical Habitat Designation.

The recovery plan recommends that federal lands in DCAs, other than national parks and wilderness areas, be designated as critical habitat for the northern spotted owl. The Recovery Team does not recommend designation of any other areas as critical habitat at this time. If progress toward reaching recovery goals does not proceed as quickly as anticipated, then designation of additional critical habitat may become appropriate in the future. The FWS should initiate efforts to revise designated critical habitat as soon as the recovery plan is approved.

DCA Management Plans.

The recovery plan recommends that management plans be prepared for each designated conservation area (DCA). These plans are an essential component of the effort to implement recovery, as they will provide a framework and objectives for carrying out specific activities, monitoring their progress, and evaluating contributions toward recovery. The Recovery Team therefore recommends that the Forest Service, the BLM, and the National Park Service initiate efforts to prepare these plans at an early date. Where practicable, plans for areas of concern should be given priority. Guidelines for preparation of these plans are contained in section III.C.2. and Appendix E. The suggested coordinating group would provide further guidance upon request from the agencies.

Consultation with the FWS.

At the request of the FWS, the Recovery Team has considered some of the issues that must be addressed during consultation.

1. Programmatic consultation.

Federal agencies may consult with the FWS on site-specific actions, such as proposed timber sales, or on programmatic actions, such as a proposed forest plan. In a programmatic review, the FWS considers impacts of a series of proposed actions that subsequently may be carried out during a period of several years. This approach is far more appropriate than attempting to evaluate the effects of each separate action. Programmatic review also is beneficial for the land management agencies because once consultation is complete, activities taken in accordance with the proposed program and the biological opinion may occur without further FWS review (unless new information is discovered that warrants reinitiation of consultation). Programmatic consultation also increases efficiency, thereby enabling the FWS to increase the technical assistance it provides to agencies. Consequently, the recovery plan recommends that consultations related to implementation of the recovery plan be carried out on a programmatic, rather than site-specific, basis.

Agency proposals to adopt the final recovery plan would be appropriate for consultation and would facilitate programmatic review of activities affecting the owl. "Adopt," in this context, means making a formal commitment in a record of decision or other similar document 1) to establish DCAs in a manner consistent with the recovery plan's recommendations, and 2) to follow the guidelines for managing the DCAs and the matrix. Such a document would provide an adequate basis for completion of consultation on activities in the matrix. Specifying impacts in DCAs in sufficient detail to complete consultation may be difficult until a DCA management plan is approved. Consultation should be initiated prior to any action in DCAs that might affect northern spotted owls until a DCA management plan has been approved and section 7 consultation on the plan has been completed.

2. Rate at which take may occur without compromising recovery.

The recovery plan includes several components designed to ensure that incidental take does not occur too rapidly in the matrix. Reserved pair areas and managed pair areas will be established in the matrix, an intensive monitoring program will be initiated, and the recovery plan will be reviewed and revised periodically. The planning processes in the federal agencies also restrict the rate at which habitat, and thus owl populations, will disappear in the matrix. These measures should provide adequate constraints on the rate at which incidental take occurs.

3. *Activities that may result in destruction or adverse modification of critical habitat.*

The recovery plan establishes guidelines for the management of DCAs and the preparation of DCA management plans. The Recovery Team recommends that the FWS use these guidelines in determining whether proposals for actions within DCAs, or for adoption of DCA management plans, would result in the destruction or adverse modification of critical habitat. The recovery plan recommends that critical habitat be revised to conform with DCA boundaries, and recommends, in the interim, that the FWS utilize the matrix management prescriptions (section III.C.2.) in analyzing the impact of actions in critical habitat outside of DCAs.

4. *Relationship between agency actions.*

The Recovery Team considered the potential relationship between the actions of different agencies. Clearly, recovery will be achieved more rapidly and effectively if all agencies comply with the recovery plan in a timely manner. Substantial lack of compliance could delay or preclude recovery. Agency actions that do not comply with the recovery plan will be required to individually satisfy the mandate of section 7 consultation in terms of adverse modification of critical habitat or jeopardy to the species. However, the accumulated impacts of actions not consistent with the recovery plan could eventually necessitate redesign of the recovery plan in a particular area. This may result in greater restrictions on timber harvest activities, including those of agencies that have complied with the recovery plan.

Past and current actions of each agency affect other agencies through impacts on the rangewide habitat condition and spotted owl populations. Impacts of actions that may affect spotted owls are evaluated in light of this baseline condition. However, due to location and ownership patterns, the recovery plan envisions little opportunity to substitute greater contributions from one agency for lesser contributions from another. This is particularly true in the case of DCAs, but also applies to the matrix. Consequently, the recovery plan generally anticipates that, during the next few years, actions proposed by one agency are unlikely to significantly affect the outcome of consultations on actions proposed by other agencies.

Nonfederal lands

The explicit federal duties described in the Endangered Species Act, combined with the concentration of northern spotted owls on lands administered by the Forest Service and BLM, give the federal government a dominant role in providing for recovery of the species. Nonfederal lands, however, comprise important portions of the spotted owl's range where federal contributions alone are not sufficient to meet recovery goals. Recovery goals for each province contain objectives for nonfederal lands, although the amount and type of contribution vary (see section III.C.4.).

Current protection afforded spotted owls on nonfederal lands derives from the Endangered Species Act's prohibition against the taking of listed species. The FWS developed biological guidance in July 1990 for reducing the risk of violating the take prohibition. The guidance recommends that landowners survey for spotted owls prior to timber harvest and avoid reducing habitat below prescribed amounts within circles around nests or activity centers (Section II.C.). This protection applies unless effective alternate measures are implemented through habitat conservation planning (under section 10 of the

Endangered Species Act) or through regulations adopted in compliance with section 4(d) of the act.

Several measures are available to achieve recovery through alternatives that would be more effective than maintenance of the current take circles (see tools for implementing recovery on nonfederal lands in this section). Recovery goal implementation likely will differ by state due to the variations in the degree of federal ownership by province, states' authorities, and availability of information about the owls. Protective management, which encourages creative approaches to recovery goal implementation, is a likely alternative to maintenance of take circles. States, landowners, the FWS would negotiate with state wildlife agencies and other interested parties to develop a plan to improve species protection and landowners' ability to manage their land. The Endangered Species Act allows protective management to serve as the basis for either conservation plans (section 10 of the Endangered Species Act) or special rules (section 4(d)).

Incentives to Participate in Protective Management.

Biologists, landowners, communities, and government agencies share several incentives to participate in protective management:

1. *Management flexibility for owl protection and timber harvest planning.*

A plan could tailor protection to fit the owl population's long-term habitat requirements, with less emphasis on short-term protection of individuals and pairs. Long-term protection could be adjusted across the landscape to improve the configuration of owl habitat blocks and to complement reserves on federal lands more effectively. The FWS could authorize an increased level of take if assurances were provided by landowners that long-term, effective mitigation efforts would be implemented providing the needed level of support for recovery. Measures such as designating certain areas to be protected or instituting FWS-approved habitat management plans might be more attractive to landowners than continuing take circles and annual surveys.

2. *Certainty of owl protection and timber harvest planning.*

Landowners would manage for long-term owl habitat needs, providing a better guarantee of habitat than the transient and potentially vulnerable circles (see section II.C.). Landowners then could plan timber harvest based on the certainty of knowing which areas would be affected by owl protection.

3. *Cost reduction of owl protection.*

Perhaps the most compelling incentive for landowners to participate in an alternative conservation program is a significant reduction of the costs of owl protection they now incur including: a) maintenance of habitat within current take circles; b) conducting annual owl surveys; and c) administrative costs associated with compliance with state forest practices regulations protecting listed species (see section II.C. for description of each state's regulations).

4. *Authorizing incidental take in exchange for implementing conservation measures identified in the recovery plan.*

Consistent with the Endangered Species Act, landowners could be authorized a level of incidental take through the HCP or 4(d) process if they are

found to exceed protection called for in the conservation objectives, allowing them to plan future timber harvests (see section II.C.).

5. *Relaxation of owl conservation requirements on federal lands in response to increased efforts on nonfederal lands.*

Some nonfederal landowners are more willing to contribute to owl recovery if they see that their efforts can lead to a reduction of conservation required on federal lands.

Guidelines for protective management.

1. Protective management should provide for the identified recovery objectives for nonfederal lands while placing the minimum burden on landowners necessary to achieve those conservation objectives.
2. Explicit goals for nonfederal lands should describe when recovery would be reached and how a landowner's efforts would contribute to overall recovery. Protective management should be based on the recovery plan's identification of the amount, spatial and temporal configuration, and function of the necessary habitat; and the target number of individuals and population trends required to meet delisting goals. The protective management plan should describe the specific implementation actions needed to implement the recovery plan's provincial goals.
3. Incentives, rather than disincentives, should be provided for finding owls, when consistent with the Endangered Species Act. Possible incentives include: a) landowner flexibility in where they protect habitat, b) reduction of total area required for protection, c) off-site mitigation for owl protection, or d) relaxation of restrictions on adjacent federal lands. Based on the recovery plan's description of contribution from nonfederal lands, landowners could be authorized some amount of incidental take where conservation measures had been implemented.
4. A protective management plan should explain the variation in owl protection requirements based on biological and physiographic distinctions and the degree of federal conservation by province, so that the public will understand the basis for differences in federal and state owl protection regulations.
5. Protective management plans should start with the recovery plan's assessment of the take prohibition.

The protective management plan should be based on the recovery plan's general assessment of the amount and rate of incidental take that can be allowed on nonfederal lands where conservation mechanisms are being put into place to accomplish recovery goals for a province. The protective management plan should identify where implementation of province recovery objectives cannot allow incidental take. Where possible, the allowable amount and rate should be identified. The form and pattern of landowner contribution to recovery can be negotiated. If areas are identified where protection of individual owls is not essential for conservation, incidental take could be permitted with minimal mitigation required. The protection of owls beyond the level needed could be considered as mitigation for impacts on owls in other nearby areas.

Land purchase and exchange should be considered for nonfederal areas essential to recovery that do not have take prohibitions to serve as an incentive to negotiate conservation with landowners.

6. Costs to landowners should be reduced.

The protective management plan should identify and analyze the cost of conservation options, and encourage selection of the lowest cost option.

The protective management plan should minimize the cost of owl protection for small acreage landowners who are less able than their neighbors with larger acreages to negotiate owl protection. Take circles may cover a substantial portion of their land, often for owls on adjacent ownerships, disproportionately restricting access to their small holdings. The conservation plan could recommend that these landowners contribute to conservation in an alternative manner.

The cost of protective management itself should be paid in such a way that landowners' incentive of cost reduction is not eliminated. If landowners are required to bear the full cost of protective management, they may find that the planning costs outweigh savings from changes in take prohibitions. For instance, state wildlife agencies could be funded to help landowners write the plans.

7. The protective management plan should recognize the role of state regulators. The plan should acknowledge the extent to which states have the authority to: a) enforce an agreement between the FWS and landowners; and b) conform state regulatory measures to the requirements of the plan. States also may have requirements independent of take prohibitions that should be assessed in the plan.
8. The feasibility and timing of implementation, such as the development of new state rules, legislative actions, board/commission approval of rules, and availability of funding, should be assessed.

Habitat Conservation Plans. Habitat conservation plans (HCPs) (see Section II.C.4.) provide an excellent opportunity for nonfederal landowners to participate in the development of protective management plans. California has been developing HCPs for northern spotted owls during the past few years. A few companies have developed HCPs and significant progress has been made on developing a statewide HCP. These efforts should be assisted and encouraged by the Recovery Team.

Regulations under section 4(d) of the Endangered Species Act.

For endangered animals, section 9 of the act directly prescribes prohibitions against taking. Take is defined broadly under the act as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." For threatened animals, section 4(d) of the act directs the Secretary to adopt "such regulations as he deems necessary and advisable to provide for the conservation of such species." The regulations applied for a threatened species may adopt any or all of the prohibitions applied by section 9 for endangered species. Since 1975, general regulations (50 CFR 17.31) have applied the full range of taking prohibitions for threatened animal species, but also have provided for the alternative of adopting special rules for particular species as necessary and advisable. The FWS has adopted special rules for more than 30 species.

Potentially, the special rule mechanism could provide great flexibility to apply taking prohibitions for the owl in those ways most likely to promote its conservation. A well-crafted special rule framework could incorporate many of the characteristics of a habitat conservation plan. Any set of rules adopted would have to pass the test of being necessary and advisable to promote the owl's conservation and would be subjected to public review in a rulemaking process.

These requirements would tend to ensure that special rules would permit take only when a more effective program (that provided long-term assurance that recovery would occur) had been implemented.

As envisioned by the Recovery Team, one possible role for federal special rules would be to ratify owl protection measures implemented under state authorities. For example, a state would adopt regulations governing the harvest of owl habitat on nonfederal lands including measures aimed at maintaining currently unoccupied habitat in some areas and possibly other measures aimed at developing owl habitat in areas where it does not now exist or is in short supply. In areas where nonfederal contributions to recovery do not require absolute prohibition of taking, restrictions on harvest might be substantially less than those that now apply under federal regulations. Federal rules might then prohibit deliberate, nonincidental taking and taking in violation of state regulation. The owl would gain benefits not available under the general taking prohibition in areas that now have no owls, and landowners would be relieved of some of the current taking restrictions within occupied owl habitat.

Another possible arrangement can be imagined that, for instance, would place more of the substantial restrictions within the federal rules or would allow various means of off-site mitigation for harvest under state regulations. Close cooperation between the FWS and the states would be necessary in the planning of any such arrangement to ensure that state regulatory authorities were adequate for implementation and that any regulation adopted would satisfy the standards of the Endangered Species Act. The adoption of federal regulations also would be subject to review under NEPA and Executive Order 12291, which requires assessments of the impacts of federal rules.

Building a climate for negotiating protective management.

Landowners are not required by the Endangered Species Act to contribute any spotted owl protection beyond their obligation to refrain from taking owls. If spotted owl recovery depends in part on conservation efforts on nonfederal lands, a climate for negotiation between landowners, the states, and the FWS must be created.

Although spotted owl recovery would be enhanced by replacing the short-term protection of individual owls with long-term conservation efforts consistent with recovery objectives, such protection efforts will not be initiated unless landowners see that it is to their benefit to participate in protective management.

Section 10 of the Endangered Species Act allows nonfederal landowners to develop habitat conservation plans (HCPs) as a condition for issuance of incidental taking permit. Section 4(d) of the act is an alternative conservation tool, which allows the FWS to promulgate "special rules" for the protection of threatened species. The FWS has indicated it will consider writing such rules if the states or landowners develop conservation or protective management plans. Rules also could provide interim management direction while an HCP is being developed.

In California, several landowners, forestry associations, environmental interests, and scientists currently participate in habitat protective management efforts with the state, FWS, Forest Service, and BLM. A few California companies are working directly with the FWS to develop their own habitat conservation plans that are expected to be consistent with the statewide plan. The statewide HCP is expected to be completed by 1993, at the earliest, underscoring the need to establish and maintain a positive climate for negotiation (see section II.C.).

The real or perceived disincentives to protective management cause delay in implementation of improved protection for the species. With each year of protective management delay, habitat is cut outside take circles, reducing options for recovery. After several years of take circle management, habitat on nonfederal lands may be found only inside those circles.

Expediency of plan development, approval, and implementation may be the most important criterion for successful protective management. Some IICPs have been completed in 6 to 12 months but others have taken substantially longer to complete. Available mechanisms to achieve recovery objectives on nonfederal lands should be streamlined to achieve the same conservation goal in a more efficient and less costly manner.

A process for incorporating implementation tools into protective management.

The following scenario presumes that the FWS finds that the approach identified for nonfederal lands is consistent with the intent of sections 4, 9, and 10 of the Endangered Species Act (i.e., consistent with the conservation of the owl), and that the states indicate their willingness to support the recovery plan and the approach for compliance under the Endangered Species Act on nonfederal lands through appropriate state laws.

1. States and the FWS would develop a detailed implementation strategy for the use of nonregulatory mechanisms, such as land acquisition, to contribute to recovery goals. (see Tools for implementing recovery on nonfederal lands in this section.)
2. The FWS, states, and landowners agree on a regulatory program as follows:
 - a. Specific landowner contributions that would allow specified levels of incidental take to occur would be identified and agreements made to implement them.
 - b. Means for ensuring and monitoring implementation of the agreements are identified and put in place.
 - c. State and/or landowners incorporate 1 and 2 (above) into protective management plans, forming the basis of either a section 10 permit or a section 4(d) rule.
 - d. The FWS pursues the appropriate action, including public review, which authorizes incidental take and ensures implementation of the alternative protective management plan. The states may require additional measures above those identified in the recovery plan or under the FWS's take guidelines.

Tools for implementing recovery on nonfederal lands.

The Recovery Team evaluated the availability and effectiveness of several mechanisms for implementation of the recovery objectives for nonfederal land, identified in section III.C.4. These mechanisms are elements of a comprehensive approach to owl conservation. Any one or a combination of these may be acceptable. This list may not be all inclusive; other equally valid ideas may exist. Anticipated implementation of the biological objectives varies by province owing to differences in the proportion of federal ownership, state authorities, and availability of information about spotted owls.

Implementation tools are defined as:

1. *Existing reserves.* State, county, or local parks, known conservation easements, or other areas that have binding, enforceable restrictions on the level of timber harvest and other forest management activities that are likely to alter the amount of suitable owl habitat. Existing reserves must be evaluated on 1) the level of current habitat within them, 2) size, 3) number, 4) spacing, and 5) timing of future habitat achieving owl suitability characteristics.
2. *Private voluntary actions.* Actions that are not required by statute or regulation, but that landowners voluntarily undertake. Actions can include, for example, long-term management plans, commitments to long rotations per uneven-aged management, or easements. Such actions must be evaluated on 1) how binding the actions are over time, 2) effectiveness in providing the conservation measures (number of owls, amount and configuration of habitat) stated in the recovery objective, 3) timing of the contribution of suitable habitat, and 4) how attractive they are to landowners to undertake.
3. *Forest practices statute and regulations.* Statutes and rules enforced by state or local government that require certain practices be used or certain habitat conditions be maintained. Depending on the definition of different types of owl habitat, these requirements can contribute to certain habitat objectives. Statutes and regulations must be evaluated on 1) current requirements for the provision of conservation measures detailed in the recovery objective, 2) whether current state statutes authorize promulgation and enforcement of additional regulations, and 3) ability, ease, and timing requirements of passing new state legislation.
4. *Prohibition on taking.* Refers to the Endangered Species Act prohibition of take of individuals, as implemented and enforced by the FWS. The relative ease of implementing an option will be increased to the extent that protection of individuals (on a case-by-case approach) implements the conservation measures in a recovery objective. The current take prohibition does not provide a long-term contribution to recovery. The success of the prohibition in contributing to recovery is variable, and dependent upon the province and existing conditions within owl home ranges. Application of take prohibition guidelines must be evaluated for consistency of results, fairness, uniformity of enforcement, and adequacy of protection.
5. *Landscape management as a basis for modifying the take prohibition.* Refers to providing suitable habitat adequate to meet the conservation objective, without necessarily focusing on the location of individuals or pairs. Landscape management may provide a basis for allowing an increased level of take. The potential role of landscape management must be assessed relative to the current number of known owl sites contributing to recovery objectives and the current burden of surveys (see Protective Management Guidelines, point #5). The Endangered Species Act provides mechanisms for landscape habitat management, including the habitat conservation plan (HCP) or section 4(d) rules.
6. *Critical habitat.* See description under Federal Implementation in section III.C.
7. *Land exchange.* Exchanging public land (fee title) for state and private lands to secure a particular location and/or management. This tool must be evaluated on 1) the availability of public land of equal value for exchange, 2) the ownership of the public land (federal, state, county), 3) the

authority of the public body to enter into land exchanges, 4) the change in public timber supply as a result of the exchange, 5) effect on local tax base, 6) the willingness of nonfederal landowners to enter into exchanges, and 7) the timing of the exchange.

8. *Purchase.* Purchase of fee title of private or state lands for reasons similar to land exchange. Purchase must be evaluated on 1) the authority of the public sector to purchase private or state land, 2) the availability of resources for public purchase, 3) the willingness of the nonfederal parties to sell, 4) the change in public timber supply as a result of the purchase, 5) effect on local tax base, 6) the timing of the purchase, 7) whether purchase is of both land or timber or whether some harvest rights are retained by seller.
9. *Timber rights trade.* Rather than purchasing or exchanging land, federal and nonfederal parties exchange timber cutting rights without altering land ownership. This should be evaluated in the same way as land purchase or exchange. Legal technicalities may need to be addressed.
10. *Conservation easements, mitigation banks, purchase or transfer of development or harvest rights.* A number of "market-oriented" tools are available for protective management. These tools are characterized by being voluntary, rather than mandatory, and allow all parties involved to base their decisions on the likely costs and benefits they will incur. The availability of these tools increases the options for efficiently meeting conservation goals.

A conservation easement is dedicated for conservation purposes, such as open space or wildlife habitat. The landowner is compensated for placing land in an easement, often through preferential property tax treatment.

The feasibility of conservation easements must be evaluated in terms of 1) the availability of suitable areas for easements, 2) the ability to administer the easements, such as the existence of land trusts, and 3) the relative benefits that a landowner could expect from entering into a conservation easement.

Mitigation banking is an offsite mitigation tool intended to compensate for habitat losses associated with future timber harvesting or other activities. Credits must be established (e.g., acres of owl habitat) prior to timber harvesting. The intent of mitigation banking is to develop a surplus of secured habitat before timber harvesting proceeds in existing suitable habitat to minimize the lag time between losses from timber harvesting and replacement from mitigation. Mitigation banking can consolidate mitigation measures from numerous small habitat losses and provide a larger off-site mitigation area.

The feasibility of mitigation banks must be evaluated based on 1) the availability of suitable sites for mitigation banks that would not have been protected otherwise, 2) the ability to establish appropriate measure of credits, 3) the institutional ability to administer the banks and monitor their effectiveness.

Transfer of development or harvest rights is another mechanism to allow higher levels of activity, such as timber harvesting, on location (destination or sink) by transferring unused rights from another location (source), thereby reducing the potential level of activities in the source location. Purchase of such rights can be used to lower the overall potential level of timber harvesting in an area by not transferring them to another location.

The feasibility of transfer or purchase of rights must be evaluated against 1) biological constraints regarding habitat quality, quantity, and location, 2) availability of institutional means to evaluate, monitor, and keep account of the trades, and 3) transactions costs to landowners and administering agencies. Any trades would have to be carefully and conservatively structured owing to the uncertainty about their biological and social and economic effects.

Implementation Scenario

In section III.C.3., the recovery plan assumes that federal agency implementation will occur in phases during the next 5 years. An approach to recovery plan implementation that is feasible and prompt might occur in three broad phases. The first phase, which should take less than 1 year, involves completion of a federal and nonfederal review of its recommendations to determine organization-specific actions needed to achieve consistency; e.g., forest and resource management plan revisions, and to carry out interim management which serves as an appropriate "bridge" to full implementation. The second phase, which likely will require up to 2 years, involves completing these general resource management planning activities, preparing the more specific DCA management plans recommended in the recovery plan, and adopting research and monitoring strategies, and initiating related on-the-ground management actions. The third phase includes further refinements of management activities, including monitoring and research, that characterize full-scale implementation, and the development of information for use in reviewing and, as necessary, revising the recovery plan.

The following outline briefly describes this phased implementation strategy. It lists anticipated activities in each phase of federal action agency (Forest Service, BLM, National Park Service), nonfederal entities, and the FWS. Some of the actions specified in each phase are interdependent, and it is assumed that they may proceed either concurrently or sequentially, as necessary.

Phase 1 (May 1992 - May 1993)

1. Federal action agencies:

- Review the recovery plan to determine management requirements needed to achieve consistency with recovery plan recommendations and take prohibitions as required by FLPMA, NFMA, NEPA, and any other applicable mandates (e.g., forest plan and regional guide revision or amendment).
- By January 1993, adopt the recovery plan and implement interim management to assure maximum consistency with recovery plan recommendations pending completion of the above management requirements.

2. States:

- Review the recovery plan to determine how to implement its recommendations under current authorities and initiate necessary actions (e.g., HCP development), in cooperation with private landowners as appropriate.
- Assess the feasibility of other actions to promote recovery plan implementation.

3. U.S. Fish and Wildlife Service:

- Promulgate a critical habitat rule to reflect recovery plan recommendations, and use it in conjunction with the DCA management guidelines as the basis for adverse modification determinations.

-
- Use the recovery plan's recommendations for the federal matrix lands as the basis for section 7 consultation and consider issuing programmatic "no jeopardy" biological opinions (including incidental take statements) for agency plans that are consistent with those recommendations.
 - Establish the coordinating group recommended in the recovery plan to provide implementation advice and assistance.
 - Issue guidance to states and private landowners to help them in preparing HCPs.
 - Assess the desirability of promulgating a special rule under section 4(d) of the Endangered Species Act.

Phase 2 (May 1993 - May 1995)

1. Federal action agencies:

- Complete actions needed to assure full adoption of recovery plan recommendations in accordance with their legal mandates.
- Adopt monitoring and research strategies.
- Prepare DCA management plans, consult with the FWS, and implement required actions including silvicultural treatments to enhance owl habitat.

2. States:

- Continue efforts to implement recovery plan recommendations for nonfederal lands, including HCP development.
- Coordinate with federal agencies and the private sector on monitoring and research efforts.

3. U.S. Fish and Wildlife Service:

- Consult on DCA plans submitted by action agencies and consider issuing programmatic "no adverse modification" biological opinions to cover future actions carried out consistent with those plans.
- Provide advice and assistance on all aspects of recovery plan implementation as required, in conjunction with the coordinating group.
- Assess progress toward recovery plan implementation and provide appropriate recommendations.
- Complete promulgation of a special rule.

Phase 3 (May 1995 - May 1997)

1. Federal action agencies:

- Complete planning requirements and be in "full implementation" regarding program operations, as well as monitoring and research.
- Report on the results of recovery plan implementation during the first 5 years.

2. States:

- Continue to implement the recovery plan's recommendations, especially those designed to provide further incentives for owl and habitat conservation.

3. Fish and Wildlife Service:

- Devote primary efforts to providing advice and assistance on owl recovery, as opposed to regulatory operations, if federal agencies are in the "full implementation" phase.
- With assistance from the coordinating group, provide guidance to federal action agencies, states, and private landowners on the process and information requirements for recovery plan review after its initial implementation phase, so that review can begin promptly in May 1997, and revision completed in a time frame that enables it to serve as a basis for agency decadal planning.

III.

C.

4. Recovery Goals and Strategies for Each Province

Overview

Recommendations made in this section are specific to physiographic provinces based on the classification of Franklin and Dyrness (1973) and Bailey (1966)(Figure 2.2.). Physiographic provinces are determined by the geophysical landscape characteristics and climate that influence the vegetation. For practical application in the recovery plan, physiographic provinces were modified based on state boundaries, current spotted owl distributions, and land ownership patterns, all of which influence the potential for management recommendations.

The status of spotted owls in each province and recommendations for recovery are summarized in this section. Recovery goals for each province are based on the status of spotted owls, threats to the population (section II.B.), and the recovery plan objective (section III.A.). These goals are intended to alleviate the primary threats in each province. Recommendations for federal and nonfederal land reflect the obligations of different ownerships under the Endangered Species Act. Indian lands are identified, but presented as neither federal nor nonfederal lands; contributions from Indian lands are described in section II.C.8.

Recovery strategies and recommendations in this section describe areas and actions by land managers that are necessary for spotted owl recovery. These include the DCAs and matrix management areas on federal land, and areas of special management emphasis on nonfederal lands.

Federal lands

The primary recovery strategy on federal lands is the establishment and appropriate management of DCAs, as described in section III.C.2., including designation of DCAs as critical habitat. DCAs are illustrated on maps provided with the draft recovery plan (Maps 1 through 3). Recommended DCA boundaries are delineated, but it is anticipated that during the response period to the draft, local land managers will suggest boundary changes to improve owl habitat management. Such proposed changes will be evaluated by the Recovery Team and incorporated into the final recovery plan, as appropriate.

In the province narratives, category 1 and 2 DCAs are listed, including approximate acreages and owl numbers. Detailed information on individual DCAs is in Appendix J.

Federal matrix lands connecting the DCAs will be managed for dispersal habitat and also include areas that require management for reserved pair areas, managed pair areas, and residual habitat areas (see section III.C.2. for a description of matrix prescriptions).

Nonfederal lands

Most of the spotted owl recovery effort will be on federal lands. However, where recovery cannot be met solely on federal lands, recommendations are made for nonfederal lands. These recommendations include the following terms:

Supplemental pair areas - Habitat delineated for pairs or territorial single spotted owls on nonfederal lands. Such habitat is managed or reserved, depending on agreements made. These areas are intended to supplement population deficiencies in the federal DCA network. The size of these areas will vary by province.

Nonfederal clusters - Habitat provided to support a localized cluster of supplemental spotted owl pair areas intended to contribute to owl population needs as described in the province narratives.

Protective management - Measures taken by nonfederal entities to conserve spotted owls and/or their habitat; measures may include participation in conservation planning (as defined in Endangered Species Act section 10) or other actions that benefit owls; entities may be states, private landowners, Indian tribes, or others.

The biological recommendations for nonfederal lands take several forms. The status of local owl populations and habitat conditions determines whether recommendations are made for specific areas, and the form of those recommendations. The biological principles underlying these recommendations are discussed in section III.B.2. Specific recommendations for each province are discussed in the province narratives. They generally can be described in one of the following ways.

1. Nonfederal lands within DCAs - Provide adequate nesting, roosting, and foraging habitat, in conjunction with federal lands, to achieve the DCAs' target for owl numbers and demographic stability. This could apply to checkerboard and non-checkerboard ownership patterns. It may include the provision of supplemental pair areas. This habitat may be either managed or reserved from timber harvest, depending on the protective management agreements for the area.
2. Nonfederal population clusters - Establishing large clusters of owls is recommended in some areas where federal lands cannot support the recovery objective without contribution from other ownerships (e.g., southwest Washington, northeast Oregon, and coastal California). This would require that habitat be provided for a cluster of breeding owl pairs with contiguous or nearly contiguous home ranges, and for floater owls and dispersing juveniles. Clusters would include 15 or more owl pairs to provide at least short-term population stability. The size of an area provided for a cluster will depend on the current suitability and natural potential of habitat, the possibility of natural disturbance, and the type and level of forest management proposed within the area. Clusters provide the opportunity to explore and test hypotheses about owl response to forest management that may not be tested within the federal DCA network. Generally, a large cluster of owl pairs would require 30,000 to 100,000 acres of habitat managed for owls.

As with supplemental pair areas, habitat for a population cluster may be either managed or reserved from timber harvest, depending on the protective management agreements for the area.

In areas of low owl density, where goals for large clusters cannot be met fully, this recommendation may be modified to provide for smaller owl clusters. Small clusters have a lower assurance of population stability than large clusters.

Alternatively, in some areas a recommendation is made for supplemental pair areas distributed across the landscape at a density lower than that described for clusters. This may provide for a self-sustaining local population but with considerably less long-term population stability than clusters.

3. Within dispersal distance of deficient DCAs - Where needed to meet the DCAs' target for owl numbers and demographic stability, provide supplemental pair areas. These areas are included in the areas of special management emphasis.
4. Nonfederal matrix management - In some areas, a recommendation is made to provide for successful dispersal of owls across a relatively short distance (less than 12 miles) to provide for interaction of owls among pair areas, DCAs, or nonfederal clusters. This normally would require foraging, roosting, and dispersal habitat distributed through the landscape, or possibly arranged in a corridor. However, nesting habitat would enhance dispersal opportunities. Nonfederal dispersal habitat will not necessarily follow the 50-11-40 rule used for federal dispersal habitat, but would be based on the long-term commitments that had been entered for the area.

Since the listing of northern spotted owls as a threatened species, protection measures have been established to comply with Endangered Species Act requirements on nonfederal lands (prohibition of take), through consultation with the FWS and through various state forest practices acts. These measures are contributing to the accomplishment of biological goals for the provinces. However, accomplishing recovery goals described in each province narrative may require a combination of existing measures and other actions that would be determined through the protective management process.

A result of the protective management process will be a further refinement of areas where recovery contributions are required. The potential for implementation of these recommendations for nonfederal lands is discussed in the implementation section for each of the states (section III.C.2.). That section also discusses the processes that would be followed to develop more specific management of owls and owl habitat on nonfederal lands. Generally, those processes would consist of states and private landowners working with the FWS to develop mechanisms under state law that would provide for owl protection while concurrently modifying take prohibition standards. Another possible approach would be to follow conservation planning under section 10 of the Endangered Species Act.

When all goals for a province have been established for federal and nonfederal land and mechanisms are being put in place to accomplish those goals, a schedule should be developed to modify take prohibitions for areas where no long-term contribution to recovery of spotted owls is required. If take prohibitions were removed, the recommendation would be to protect the nest site during the breeding season. While only areas of special management emphasis are discussed, the spotted owls and habitat outside of these areas make contributions to current population maintenance. Until long-term recovery commitments are in place on nonfederal lands, the contribution of these owls and their habitat is important for short-term maintenance of the owl population.

Olympic Peninsula Province

Province description

The Olympic Peninsula is a relatively isolated province in northwest Washington, bordered on three sides by bodies of water. The central portion of the peninsula is a mountain range with high elevation ridges radiating from the central area throughout Olympic National Park and Olympic National Forest. Currently, spotted owl habitat is located generally in mid-elevation forests along major river systems draining the mountains.

Numbers of owls currently are estimated between 175 and 200 pairs (111 pairs are known at this time). Productivity of the population appeared to be extremely poor in the mid-1980s, but was good in the 3 years prior to 1991. Productivity in 1991 was very poor (Forsman, pers. comm.). Reasons for these fluctuations and whether there is a pattern to the fluctuations are unknown. Owls generally occur on federal land at mid-elevations, but a smaller number of owls resides on primarily nonfederal lands in lower elevational habitats in the western portion of the peninsula.

Threats to the Olympic Peninsula spotted owl population include relatively low numbers of owls, the significant risk of large-scale disturbances (wind and fire), and stochastic patterns of productivity. There is a significant threat to habitat from large-scale windstorms in the western portion of the peninsula (Appendix F), and the threat of wildfire in the east portion. These threats to habitat create a risk to owl population stability. The recovery strategy is to alleviate these long-term threats to the population by protecting a large proportion of existing owl pairs and reestablishing connections to spotted owl populations in the Washington Cascades and northwestern Oregon. The entire Olympic Peninsula is considered an area of special management emphasis.

The major Indian reservations in this province are the Makah and Quinault. The Makah Reservation is not known to include spotted owls or their habitat. The contributions of the Quinault Nation are described in section II.B.

Biological goals and implementation on federal lands

One large DCA is recommended on federal lands in the interior Olympic Peninsula. This includes all suitable habitat in Olympic National Park and a large proportion of Olympic National Forest adjacent to the park. This DCA, WD-36, has four additional parcels which are separated from the body of the DCA. Another recommended DCA (WD-45) is the Olympic National Park coastal strip, encompassing a relatively narrow strip of land from Lake Ozette south to the Queets River.

Three small parcels of WD-36 are recommended in the Soladuck Ranger District. These are important a) to help maintain distribution in the western portion of the peninsula, b) to provide demographic support to the large interior portion of WD-36 until the owl population meets future expected numbers, and c) in conjunction with nonfederal lands, to support habitat connectivity with Olympic National Park's coastal strip.

Also, a parcel of WD-36 is recommended in the southern portion of the Hood Canal Ranger District. This habitat parcel should be maintained to serve as a nesting area for a future small cluster of spotted owls. A cluster of owls may be needed in this area to provide for future interchange of owls between the Olympic Peninsula and the western Washington lowlands province.

The large interior DCA (WD-36) is recommended for several reasons specific to the peninsula (section II.B). Historical timber harvest in Olympic National Forest has occurred in lower elevations, removing habitat and restricting the remaining owls in the national forest to a relatively narrow band encircling the periphery of Olympic National Park. When the remaining national forest habitat is combined with the habitat in Olympic National Park, it results in a ring of habitat surrounding the high elevation area at the center of the park. The high elevation interior area does not contain habitat suitable for owls and probably restricts dispersal.

Because of this unusual configuration of habitat, a single large DCA is recommended to help ensure connectivity within the population. A series of smaller

DCAs, separated by dispersal habitat, would provide a lower probability of successful dispersal, given the geography of the peninsula. In addition, the large DCA will protect habitat for enough owl pairs to reduce the risk from stochastic environmental or demographic events. This is an extremely important consideration on the Olympic Peninsula because the spotted owl population here virtually is isolated from the remainder of the owl's range (USDA 1988; Thomas et al. 1990).

There are 89 known pairs of owls located within federal lands in the DCAs. These represent 97 percent of all owl pairs located on federal lands in the province (Table 3.3 and Figure 3.7). The DCAs contain 70 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province (Table 3.4 and Figure 3.8).

Table 3.3. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Olympic Peninsula province. (More detailed information, including projected owl pairs on nonfederal land, is in Appendix J, Table J.1.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
WD-36	847,086	97	446,519	84	2	124	193
WD-45	35,439	100	-	5	0	8	8
Totals:	882,525	97		89	2	132	201
Total for all lands in province:			636,839	92	19		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.4. Summary comments on the designated conservation area (DCA) network in the Olympic Peninsula province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
WD-36	A DCA is recommended within and around Olympic National Park to increase habitat connectivity among major drainages, to include habitat at a variety of elevations, and to support a potentially isolated population. It is delineated as one large area, plus four small satellite areas.
WD-45	This DCA lies in the coastal strip of Olympic National Park. It is expected to support eight spotted owl pairs.

Biological goals and implementation on nonfederal lands

The overall goal for nonfederal lands on the Olympic Peninsula is to provide demographic support to the Olympic Peninsula owl population. Specific province objectives are to protect individual pairs and to increase habitat connectivity between Olympic National Park's coastal strip and interior federal land.

Given the current distribution of remaining owls and habitat there are several possibilities to meet recovery needs. One option for providing demographic support is through protection of spotted owls where they currently occur throughout the peninsula, since remaining spotted owl habitat on nonfederal land is located close to federal land. Habitat to support small clusters of three to four owl pairs in conjunction with protective measures on federal land would be desirable to meet the province objectives.

The recommended option is to provide demographic support and increased habitat connectivity in the western portion of the Olympic Peninsula, from Lake Ozette south to the Queets River and from the coast east to federal ownership. Currently, there are approximately 35 known spotted owl activity centers located on both federal and nonfederal land in the area. Since individual owl activity centers overlap several ownerships, protective management on nonfederal lands should be integrated and coordinated with federal lands.

Long-term protective measures that increase connectivity between Olympic National Park's coastal strip and the interior peninsula should be planned to provide maximum overlap with needs of other vulnerable species (e.g., salmon, marbled murrelet, fisher, northern goshawk). Planning should consider the need for contiguous habitat between Olympic National Park's coastal strip and the interior peninsula, as this would provide benefits to spotted owls and may be required for other species associated with late successional forests. Measures to increase spotted owl population connectivity are recommended in one or two locations between interior federal ownership and Olympic National Park's coastal strip. Currently, several areas are capable of reestablishing this connectivity in the foreseeable future. These areas of contiguous habitat should be at least 1 mile wide to provide for breeding pairs of spotted owls.

Long-term provisions for 20 to 30 pairs of spotted owls on all ownerships in this area should meet province objectives for demographic support by a) maintaining owls in the western portion of the province in a range of elevational and ecological conditions and b) increasing the likelihood of successful dispersal between the coastal strip and the interior. Small clusters of owl pairs are preferred to individual owl pair protection and, to the extent feasible and practical, should be considered. Individual owl pairs should be protected with supplemental pair areas. The amount of owl habitat should be equal to the median amount learned from research studies in the province. Owl habitat should be provided to the maximum extent possible within an area equal to the median home range size for the province.

The establishment of areas of habitat connectivity, pair protection, and/or small clusters dramatically would enhance dispersal capability in this area. The need for additional areas of dispersal habitat should be evaluated when these areas have been designated.

Additional information would be beneficial in planning nonfederal contributions on the Olympic Peninsula. The spotted owl life history simulation model developed by Forest Service researchers (discussed in Appendix A) and demographic information from on-going research could be a valuable tool in plan-

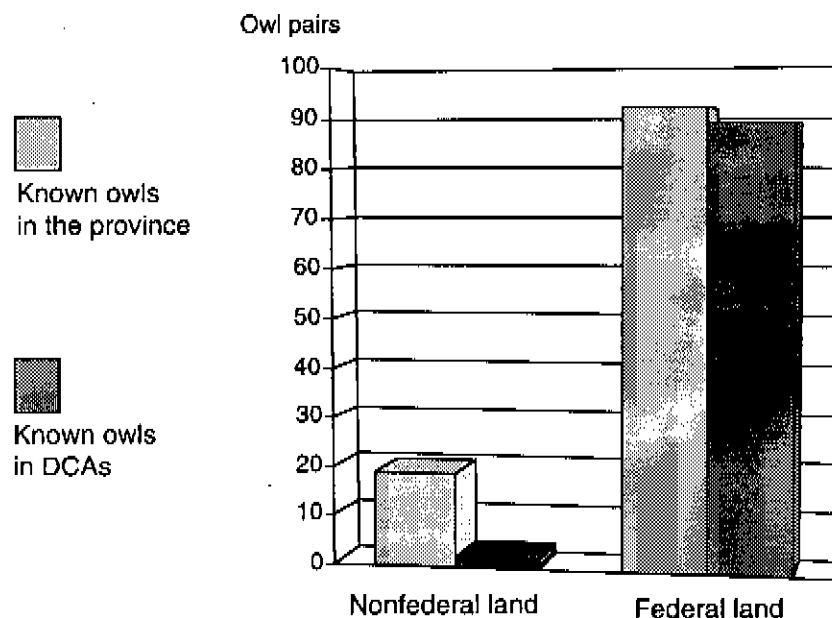


Figure 3.7. Known owl pairs in the Olympic Peninsula province and in DCAs within the province.

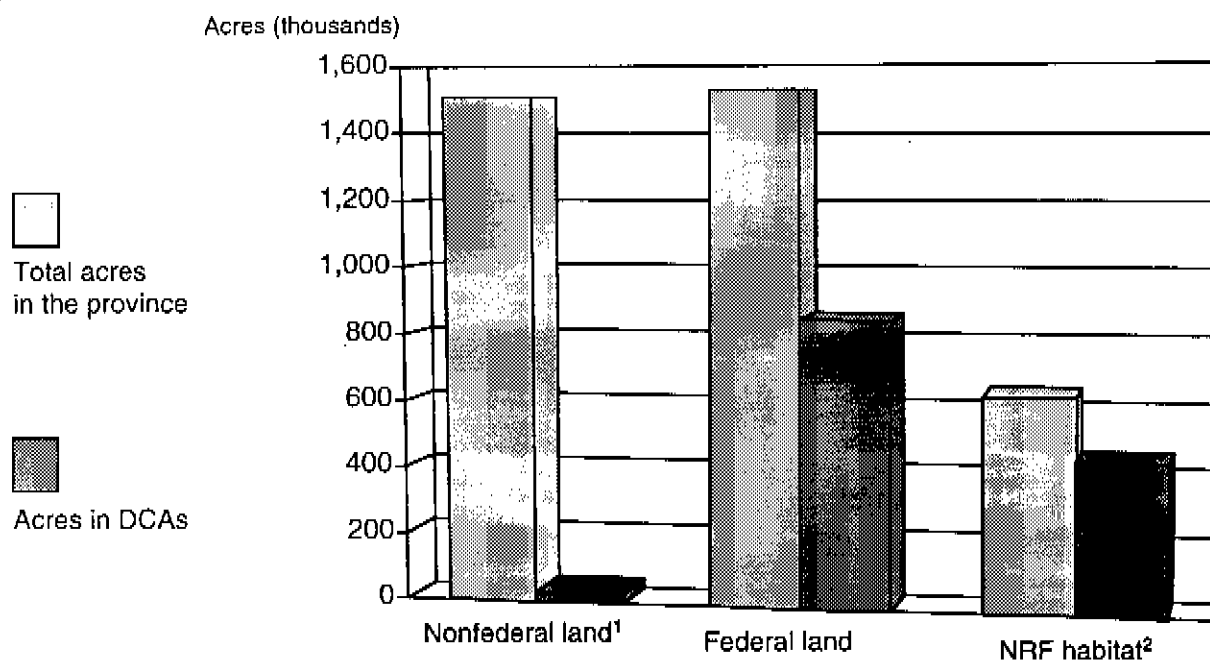


Figure 3.8. Acres in the Olympic Peninsula province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

ning. Also, several unsurveyed areas of potential habitat remaining on the Olympic Peninsula should be surveyed in preparation of protective management plans.

The State of Washington has proposed several voluntary actions for state trust lands in this area that can address the objectives of improving spotted owl population connectivity and protecting individual owl pairs. These actions include deferral of timber harvest on 15,000 acres of spotted owl habitat; transfer of 3,000 acres of ecologically sensitive land from trust to conservation status, with compensation; and creation of a 260,000-acre Olympic Experimental State Forest (all state land in the western half of the province, north of the Queets River). The recovery plan recommends that the experimental forest meet the province recovery objectives discussed earlier and develop and test silvicultural prescriptions aimed at improving compatibility between protection of owl habitat and commercial forest management. Objectives of the silvicultural prescriptions could include (1) accelerating habitat development of currently unsuitable habitat, (2) creating post-harvest conditions conducive to rapid redevelopment of habitat, and (3) maintaining habitat suitability following harvest. Knowledge developed through work on the experimental forest could be useful to owl conservation over time throughout the Olympic Peninsula and in other provinces.

Prohibitions on take also are contributing to the province recovery objectives by protecting known owl activity centers. However, protective management and conservation planning, as described in section III.C.3., could lead to more efficient conservation actions and increase the feasibility of meeting the recovery objectives for the province. For some private landowners, it also may be possible to negotiate contributions of land in trade for relief from take prohibition (see III.C.3.). State forest practices rules also could be used to ensure protection of known owls, where agreed upon.

Land exchange or purchase could contribute to the province objectives, but the prohibitive expense makes it appropriate only in special circumstances. Additions of lands to Olympic National Park and/or Olympic National Forest could help achieve recovery objectives.

Western Washington Lowlands Province

Province description

The western Washington lowlands province lies in southwest Washington and consists largely of nonfederal ownership, including major urban, industrial, and agricultural areas in Washington. It includes the Puget Trough, which encompasses the Everett, Seattle, and Tacoma urban areas. The province occupies a key position in the spotted owl range; it is the only area where connectivity could be reestablished with the currently isolated population of northern spotted owls on the Olympic Peninsula.

The majority of forestland in this province is owned by the State of Washington or large industrial timber corporations. As a result of timber harvest, northern spotted owls have been virtually eliminated from the province; only four activity centers are known in the province. Major threats to the remaining owl territories include low habitat quantity, poor distribution of habitat and owls, and local population isolation.

A contributing concern in this province is the risk to the owl population in the adjacent Olympic Peninsula. To alleviate this threat of population isolation, population connectivity should be reestablished across the Washington lowlands province to both the Washington Cascades and northwestern Oregon.

Because of the distances involved, the presence of breeding population clusters will be necessary to provide a meaningful level of connectivity. Reestablishing population connectivity is the main recovery goal in this province.

Biological goals and implementation on federal lands

Essentially the only federal land in the province is the Fort Lewis Military Reservation which is recommended as a DCA (WD-43). No spotted owls currently are known to occur on these lands and habitat is generally in young forest. Fort Lewis is in an important location to reestablish demographic interchange between spotted owls in the Cascade Range and the Olympic Peninsula. Forestlands should be managed to develop characteristics of spotted owl habitat.

Table 3.5. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Washington lowlands province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.2.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
WD-43	81,590	97	0	0	0	0	21
Total for all lands in province:			0	0	3		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.6. Summary comments on the designated conservation area (DCA) network in the western Washington lowlands province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
WD-43	This DCA is located entirely on the Fort Lewis Military Reservation. Forests are generally less than 70 years old. It will improve connectivity with the Washington Cascades and the Olympic Peninsula populations. The area has the future habitat capability to support 21 pairs of owls.

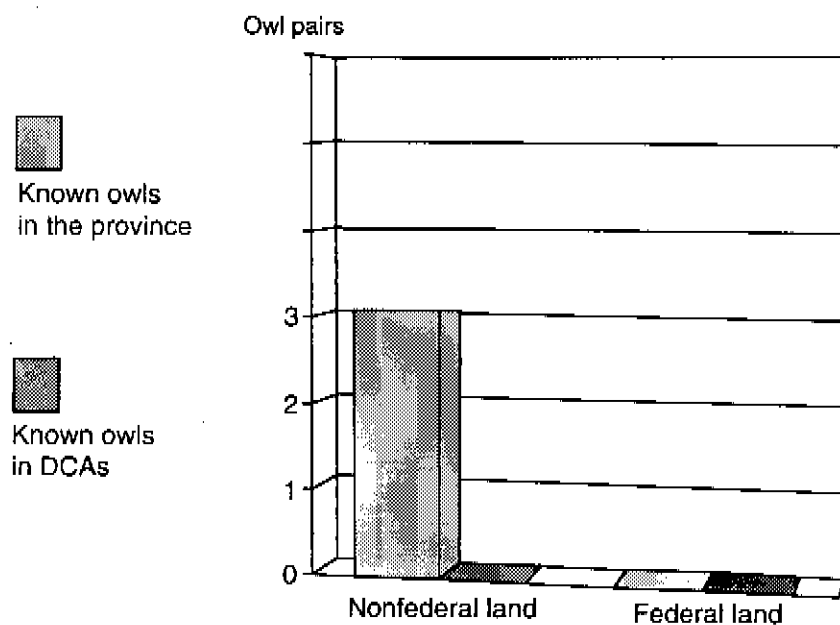


Figure 3.9. Known owl pairs in the western Washington lowlands province, and in DCAs within the province.

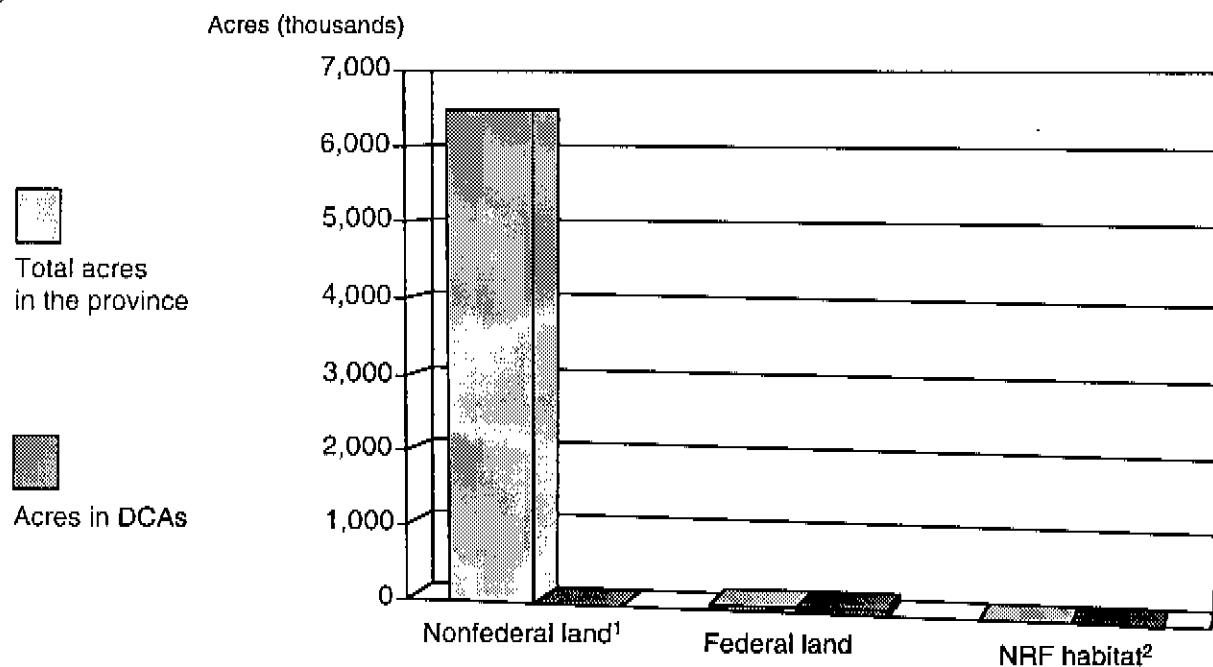


Figure 3.10. Acres in the western Washington lowlands province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

Biological goals and implementation on nonfederal land

The low habitat quantity and poor habitat distribution requires that the entire province be identified as an area of special management emphasis. However, within the province there are areas which should receive focused attention to be most effective in achieving province objectives. Reestablishing population connectivity is the main recovery objective in this province. To achieve this, both owl clusters and dispersal habitat are recommended. In the future, nonfederal lands should be managed to provide clusters of supplemental pair areas to contribute to the objective. Such clusters should be:

- 1) designed for a minimum of 15 future spotted owl pairs,
- 2) spaced a maximum of 12 miles apart,
- 3) dispersal habitat should be provided between clusters with dispersal areas as continuous as feasible.

There are several reasons that make the objective difficult to achieve. Since there are few existing owl sites in this province, prohibition on take or negotiating conservation in trade for relief from take prohibition within the province are not feasible means of contributing to recovery. A few relatively small preserved areas exist in southwest Washington, such as the State Natural Heritage Program lands, but these are not adequately sized to support clusters of breeding pairs, or located to serve well as dispersal habitat. Provision of breeding habitat independent of known owl sites cannot be required under current state forest practices law.

To establish breeding clusters in this province, land acquisition appears to be the only effective strategy. This is because there are limited opportunities for federal/nonfederal land exchanges in this province. But purchase of land and timber sufficient to meet the objective would be prohibitively expensive (more than \$2 billion).

To reduce this cost, purchase of bare land, or land with some timber harvest rights reserved to the seller, may be feasible (possibly reducing costs to \$150 million). This approach would delay achievement of the recovery objective by several decades because the forest would have to regrow into owl habitat. However, the continuing threat to the owl population on the Olympic Peninsula, necessitating reestablishment of connectivity, is anticipated over many decades. Even at the lower cost, funding for this approach may be available only over a number of years, and would be considered along with acquisitions to meet recovery objectives for other provinces in Washington.

To answer the need for dispersal habitat, the only effective mechanism appears to be a combination of incentives for landowners and forest practices regulations. New forest practices regulations would have to be developed, and dispersal habitat would have to be well defined. Achievement of the dispersal objective probably is feasible, but would contribute to recovery only if applied in combination with successful establishment of breeding clusters.

The following recommendations are provided for recovery planning in the western Washington lowlands province:

- Continue surveys of potential owl habitat.
- Continue protection of remaining northern spotted owls. The owls should be protected with supplemental pair areas. These areas should be at least as large as the median home range size for pairs in the neighboring Olympic Peninsula province (size information from the Olympic Peninsula province is being used because studies have not been conducted in this province to provide a size estimate). It is recommended that delineation and management of these areas follow guidelines similar to those for reserved pair areas or managed pair areas on federal lands.

-
- Initiate long-range planning efforts to develop conservation measures for the northern spotted owl.
 - Consider the needs of other species in designs for clusters.

Western Washington Cascades Province

Province description

The western Washington Cascades province lies along the western slope of the Cascade Range, from the Columbia River to the Canadian border. Approximately 197 spotted owl activity centers, including 166 confirmed pairs, occur in the province. Of these, 179 activity centers and 150 pairs are on federal land. Significant topographic differences occur between the northern and southern portions of the province. The northern area is dominated by high elevation mountains and ridges unsuitable for spotted owls, restricting the suitable spotted owl habitat to lower elevations. The southern portion is much less dominated by mountainous areas, and spotted owl habitat is potentially more continuous. However, it is still highly fragmented by past timber harvest.

Threats to spotted owls in the province include low rates of reproduction in the northern portion and loss of habitat throughout the province. During the past 20 years the checkerboard lands in the Interstate 90 corridor and the Mineral Block in the Gifford Pinchot National Forest have been heavily harvested. (The Mineral Block is a disjunct portion of the forest north of Highway 12 and west of Highway 17). These lands currently support low densities of spotted owls.

Five areas of special management emphasis have been identified and these are reflected in the nonfederal province objectives and recommendations.

Northern half of the province (north of Interstate 90). Habitat in this area is naturally fragmented because of the mountainous terrain, and the fragmentation has been worsened by timber harvest. Spotted owls and their habitat are now poorly distributed in this area. No large clusters of owls currently occur here.

Interstate 90 corridor. Timber harvest in this area of checkerboard ownership has resulted in limited nesting, roosting, and foraging habitat. Low amounts and poor distribution of habitat in this area are serious concerns because they limit opportunities for dispersal between the north and south halves of the western Washington Cascades and between the western and eastern Washington Cascades through the area of Snoqualmie pass.

The Columbia Gorge. Spotted owl populations in Oregon and Washington are separated by the Columbia River. The historic and current levels of interactions between populations in the two states are unknown, but there has been a significant reduction in habitat in the Gorge due to both timber harvest and urban development.

The Mineral Block. This area is key to the potential for population connectivity between the western Washington Cascades and the Olympic Peninsula. Habitat and owls in this area are limited by the pattern of timber harvest within checkerboard ownership.

Slouxon Creek. This area is located southwest of the Mt. St. Helens National Volcanic Monument. It provides opportunities to manage for owls in lower elevation habitat on the west side of the Cascades, with potential benefits to population connectivity with the Oregon Cascades and the Olympic Peninsula.

Table 3.7. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Washington Cascades province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.3.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
WD-1	153,631	96	92,280	15	1	23	41
WD-2	111,756	100	83,240	14	0	25	31
WD-2N	52,239	92	33,560	8	0	10	12
WD-2W	16,781	96	10,040	3	0	3	2
WD-3	175,414	98	103,295	16	0	23	45
WD-4	133,304	82	56,001	10	2	14	30
WD-8	87,945	96	44,120	6	0	11	24
WD-9	104,211	98	58,248	10	0	14	28
WD-10	54,737	59	14,880	4	0	5	8
WD-11	12,535	99	4,830	1	0	1	1
WD-17	29,740	53	7,400	1	0	3	2
WD-18	27,331	92	11,880	2	0	3	5
WD-19	38,404	92	19,560	1	0	7	9
WD-19W	13,517	91	6,840	2	0	3	3
WD-25	31,273	58	17,320	3	0	5	8
WD-26	23,081	53	12,640	3	0	4	5
WD-26W	14,310	100	8,720	2	0	3	3
WD-27	33,360	98	16,760	4	0	5	8
WD-27S	9,677	96	6,480	1	0	2	2
WD-28	76,925	100	51,360	6	0	14	20
WD-29	26,414	100	18,840	2	0	5	5
WD-30	14,424	100	9,520	4	0	4	3
WD-31	27,386	100	19,423	1	0	5	6
WD-32	37,995	99	19,077	2	0	4	9
WD-34	87,698	100	27,912	0	0	7	10
WD-35	14,448	100	5,435	0	0	2	2
Totals:	1,408,536	94	759,661	121	3	205	322
Totals for all lands in province:			1,431,104	150	16		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Biological goals and implementation on federal lands

The recovery plan recommends that 26 DCAs be delineated in the province (Tables 3.7 and 3.8). Seven of these meet the criteria for category 1 areas. The DCAs vary in size from 9,600 to 175,000 acres, and 121 pairs of spotted owls have been confirmed on federal lands within their boundaries. This represents about 80 percent of all pairs located on federal lands within the province (Figure 3.11). The DCAs also contain approximately 53 percent of the nesting, roosting, and foraging habitat located on federal land in the province (Figure 3.12).

Table 3.8. Summary comments on the designated conservation area (DCA) network in the western Washington Cascades province. (Section III.C.2.a. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
WD-1, WD-2, WD-3	These are category 1 DCAs. They currently contain sufficient habitat and owl numbers to function as large clusters of interactive owl pairs.
WD-4, WD-8, WD-9, and WD-28	These also are category 1 DCAs. However, they are currently estimated to contain fewer than 20 pairs of owls, each with potential to increase to 20 pairs.
WD-2N, WD-2W, WD-10, WD-11, WD-17, WD-17 through WD-19, WD-19W, WD-25, WD-26, WD-26W, WD-27, WD-27S, WD-29 through WD-32, WD-34, and WD-35	These smaller, multipair areas were delineated in this area to address local demographic, distribution, and linkage concerns. Because of natural habitat limitations and low population densities, they can only potentially support 2 to 19 pairs of owls.

Federal matrix forests will be managed under prescription A (section III.C.2). In addition, four areas have been identified where the establishment of reserved pair areas is needed to compensate for deficiencies in the DCA network. Ten reserved pair areas are needed in the Interstate 90 corridor area north of Mt. Rainier (between DCAs WD-4 and WD-17); eight are needed between DCAs WD-25 and WD-19; and four are recommended north of Darrington (among DCAs WD-9, WD-28 and WD-30).

Biological goals and implementation on nonfederal lands

Specific recommendations for nonfederal contributions are described in the following sections for each of the areas of special management emphasis.

Northern half of the province (north of Interstate 90). The primary recommendation for nonfederal land in this area is to provide dispersal habitat between WD-8 and DCAs to the north, east, and south. Such habitat should provide dispersal for the maximum number of juvenile owls dispersing from adjacent DCAs. Protective management could contribute to the objective, as could land exchange. If new state forest practices regulations were developed, and dispersal habitat was well defined, such regulations also could contribute to this objective.

Interstate 90 corridor. There are several recommendations for nonfederal contributions to recovery in this area. The first is to provide for nesting, roosting, and foraging habitat within or directly adjacent to DCAs with checkerboard ownership. These are WD-4 and WD-17. The second recommendation is to provide nesting, roosting, and foraging habitat to help support the reserved pair areas that will be established on federal land in the checkerboard ownership between these DCAs. Contributions

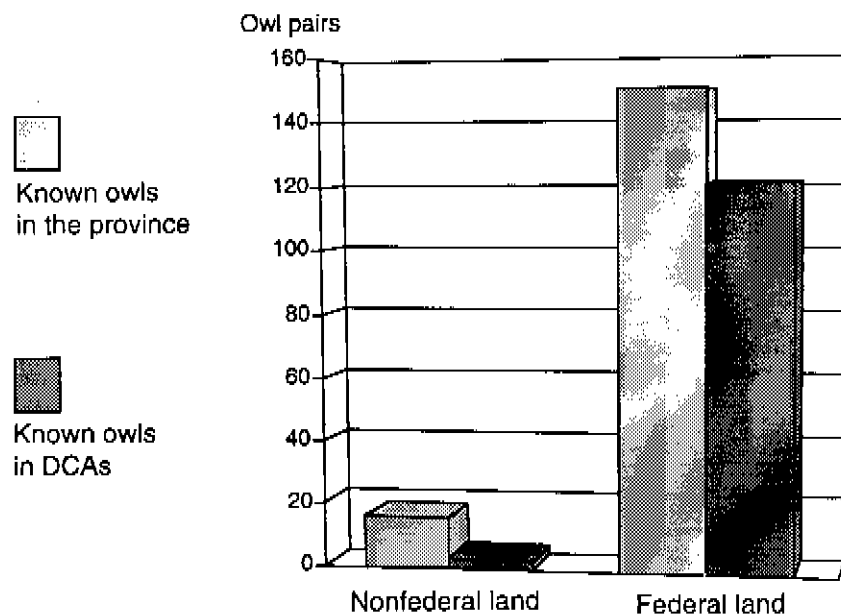


Figure 3.11. Known owl pairs in the western Washington Cascades province and in DCAs within the province.

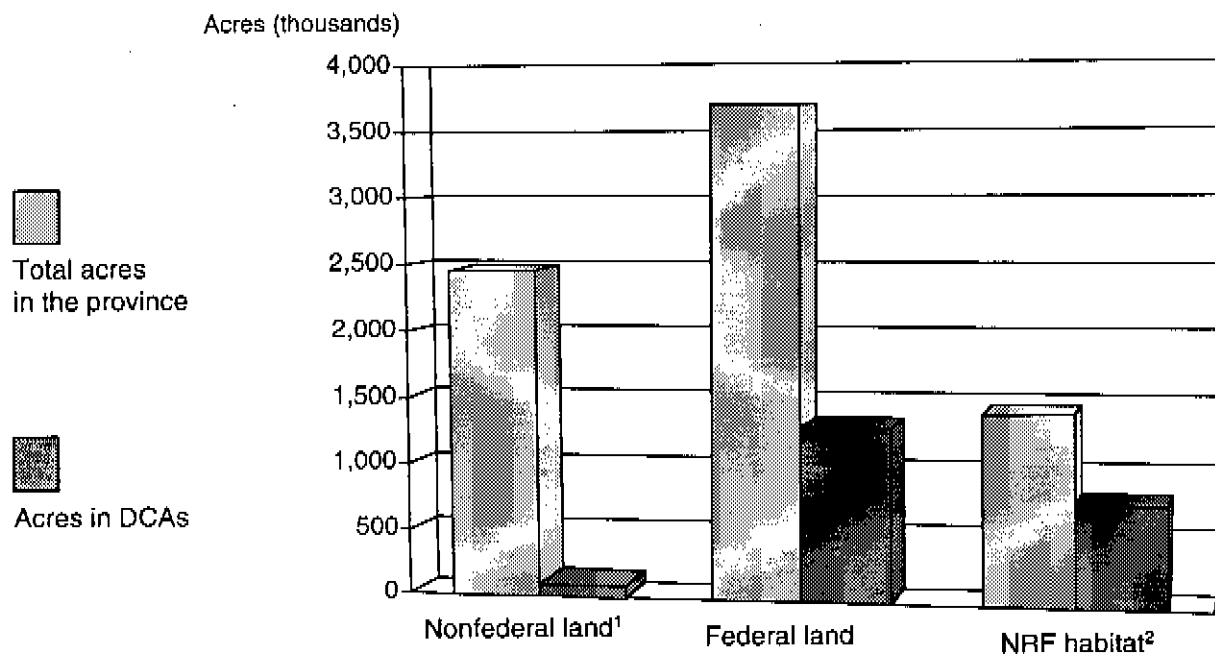


Figure 3.12. Acres in the western Washington Cascades province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

from nonfederal lands are needed to support these 10 sites because sufficient habitat does not occur on federal lands. These contributions are needed until habitat in the DCA recovers. The final recommendation is to provide dispersal habitat on other nonfederal lands between WD-4 and WD-17.

In the Interstate 90 corridor area, prohibition of take on nonfederal lands currently is contributing to recovery. Nonfederal landowners currently are affected by prohibitions on take at approximately 20 owl sites in DCAs in the Interstate 90 corridor, and a smaller number of sites to the north. Not all of these restrictions are contributing to the identified recovery objective. Protective management, as described in section III.C.3., could lead to more efficient conservation measures and improve achievement of recovery objectives. State forest practices rules also could be used to ensure implementation of agreed on protection of known owls. If there is an adequate federal nexus, federal critical habitat designation could provide additional protection. The City of Seattle currently is protecting suitable habitat within its Cedar River watershed (near WD-17). Within this watershed the unsuitable habitat is expected to develop into suitable habitat over time.

In this area, as in all other parts of Washington, known owl pairs currently are partially protected through federal prohibition on take. However, protection is limited to 40 percent of suitable habitat within a 1.8-mile radius of the site center. Additional habitat protection may be needed to ensure long term survival of the pair. Additional protected acreage could be negotiated in exchange for relief from take prohibition on other owls, or a larger area could be managed actively to provide protection in the long term in exchange for reduced habitat protection in the short term (see section III.C.3.). Opportunities to negotiate will be reduced to the extent that the recovery objective already requires protection of most currently known owl pairs. In that case, little incentive exists for landowners to make additional contributions. Land exchange or purchase may be necessary in some cases to increase the level of protection.

Columbia Gorge. The portion of the Gorge through which spotted owls might move between the Washington and Oregon Cascades is generally located between DCAs WD-1 and OD-1. This includes a portion of the eastern Washington Cascades province. The recommendation for the area in the western Washington Cascades is to provide protection for currently known activity centers on nonfederal land using supplemental pair areas. These owls should be protected within an area equal to the median home range size within the province. The acreage of habitat provided should be at least the median amount of habitat used within home ranges. Seven pairs and single owl sites currently are located in the Columbia Gorge.

An additional recommendation is to develop strategies for future recruitment of additional habitat (Appendix G) to provide a density of four owl pairs per township in the Columbia Gorge.

Current prohibitions on take are contributing to the accomplishment of recovery objectives in the Gorge. However, there is little opportunity to negotiate additional landowner contribution in exchange for relief from take prohibition because there are only a small number of known owl sites; most are clustered near the national forest boundary; and most are needed to meet the objective for pairs in the area. State forest practices regulations can help ensure protection of known owls, and, if new regulations were developed, could provide dispersal habitat among pairs.

However, state regulatory protection of breeding habitat independent of known pairs likely would require legislative action to change the statute.

Some state-protected habitat currently exists at Beacon Rock State Park and the adjacent Natural Resource Conservation Area at Table Mountain. Land exchange or land purchase to bring additional land into public ownership for habitat protection appears necessary to meet the recovery objective to establish large areas of new breeding habitat. Some land acquisition is occurring in conjunction with establishment of the Columbia Gorge National Scenic Area. However, this would be very expensive (\$10 million to \$20 million per owl pair) and would be feasible only with substantial federal funding.

The Mineral Block. This area is of particular importance for contributions from nonfederal lands. As currently mapped, the DCA on the Mineral Block (WD-10) has a future capability of supporting 14 pairs of spotted owls, including checkerboard nonfederal lands (Appendix J, Table J.3.). There are presently five known territories on all lands in the DCA. Contributions, in the form of supplemental pair areas, on nonfederal land inside of, and directly adjacent to, WD-10 are recommended to increase the capability of the DCA so that it will support a minimum of 15 pairs of spotted owls. It is also recommended that dispersal habitat be provided on nonfederal land between DCA WD-10 and DCAs W-2N and W-3.

Within WD-10, prohibitions on take currently are contributing to the province objective of supplementing the DCA. Approximately 10 known owl activity centers occur in and near this DCA. Protective management, as described in section III.C.3., could improve achievement of recovery objectives. State forest practices rules also could be used to ensure protection of known owls, where agreed upon. However, if most or all known owl pairs are needed to meet the DCA objective, opportunities will be limited to use protective management to achieve other nonfederal contributions. This also will reduce opportunities to gain contributions of dispersal habitat among WD-10 and WD-2N and WD-3. These contributions are extremely important to the development of stable owl subpopulations in the province.

Siouxon Creek (northwest of WD-1). The recommendation is to provide a small group of spotted owls (three to four pairs) in conjunction with federal ownership as either a small cluster or as supplemental pair areas. This area is important to maintain distribution within the province and provides a potential link in establishing a second connection between spotted owls in Washington and Oregon across the Columbia River.

Prohibition on take will help accomplish this objective. Opportunities to negotiate more efficient contributions are limited since there are only a few known owl sites in this area and all are needed to accomplish the objective of providing a cluster. Some voluntary action on state-owned lands is possible but is not likely to achieve the recovery objective given current management requirements for these lands. Land acquisition through purchase or exchange is possible but would require up to \$100 million. Less-than-fee acquisitions may have the potential to contribute to the recovery objective in this area. Achievement of the objective in the near term is feasible to a degree.

Eastern Washington Cascades Province

Province description

The province is located on the east slope of the Cascade Range in Washington, from the Columbia River to the Canadian border. Approximately 162 northern spotted owl activity centers have been found in the province; most are on federal land in the central and southern portion of the province. In the northern portion of the province, high mountains create naturally fragmented habitat with low potential for development of large clusters of spotted owls. In the southern portion of the province, the highest densities of owls appear to be on the Yakima Indian Reservation (recovery contributions provided by the Yakima Nation are described in section II.C.8.).

Table 3.9. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the eastern Washington Cascades province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.4.)

DCA Ident. Number	Acreage		Owl Pairs				
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
WD-1N	34,525	99	25,640	6	0	8	8
WD-5	88,136	61	33,240	9	2	11	14
WD-6	92,263	93	54,520	12	1	16	24
WD-7	112,052	91	58,960	7	1	15	28
WD-12	64,439	97	29,280	8	0	8	16
WD-14	11,305	100	3,520	2	0	2	2
WD-15	52,167	97	33,400	2	0	9	13
WD-16	60,639	74	31,640	8	6	9	11
WD-20	26,668	93	9,120	3	0	3	5
WD-21	24,572	71	4,680	6	0	6	5
WD-22	11,107	68	1,680	2	0	2	2
WD-23	13,222	85	6,440	1	0	2	3
WD-24	68,544	100	37,760	5	0	10	18
WD-33	55,176	96	5,600	2	0	6	10
WD-37	16,935	97	1,400	1	0	2	2
WD-38	23,878	100	3,040	3	0	3	4
WD-39	11,480	100	1,920	1	0	1	1
WD-40	20,104	100	4,880	1	0	2	2
WD-41	12,803	100	3,480	1	0	1	2
WD-42	26,245	100	11,200	3	0	3	5
WD-44	9,962	100	3,000	1	0	1	1
Totals:	836,222	90	364,400	84	10	120	176
Totals for all lands in province:			798,394	121	36		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.10. Summary comments on the designated conservation area (DCA) network in the eastern Washington Cascade province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
WD-6, WD-7	These are the category 1 DCAs in the province. They are currently estimated to contain fewer than 20 pairs of owls, but each has the potential to increase to 20 pairs.
WD-1N, WD-5, WD-12, WD-14 through WD-16, WD-20 through WD-24, WD-33, WD-37 through WD-42, and WD-44	Because of natural habitat limitations and low population densities, these remaining DCAs are all category 2s. They have potential capabilities to support from 1 to 18 pairs of owls. They were delineated in this area to address local demographic, distribution, and linkage concerns.

General threats to spotted owls in the province include loss of habitat, habitat fragmentation, lack of stable owl populations, and high risk of large-scale fire and insect damage (Appendix F). Historically, ground fuels were decreased by frequent fires that occurred as low intensity underburns that burned without killing overstory trees. A history of fire suppression has resulted in an accumulation of fuels, especially on national forest lands. This accumulation increases the probability of stand-replacement fires that potentially could eliminate northern spotted owl habitat from large-scale landscapes.

Three areas of special management emphasis have been identified for recommendations on nonfederal lands; specific recommendations are provided to help alleviate threats to owls in these areas.

Biological goals and implementation on federal lands

It is recommended that two category 1 DCAs, and 19 category 2 DCAs be established in this province (Tables 3.6 and 3.7). They vary in size from 9,900 acres to more than 112,000 acres, and include a total of 94 owl pairs of which 84 are located on federal lands. These represent 69 percent of the total known owl pairs on federal lands (Table 3.9 and Figure 3.13). The DCAs contain 46 percent of the nesting, roosting, and foraging habitat on federal land (Figure 3.14).

The DCA recommendations for the area north of Lake Chelan (north of DCAs WD-37 and WD-38) reflect low viability of owl populations that result from natural and human-caused habitat fragmentation. In this area, all known activity centers have been delineated as small DCAs. Any future activity centers that are located also should be added to the DCA network. The long-term recovery objective in this area is to develop small DCAs with owl clusters of two or more pairs, since category 1 DCAs are not possible.

In addition to the DCA network, threats to the owls in the province require areas of specific matrix management recommendations. The bulk of federal matrix land is recommended for management prescription A (see III.C.2.), but

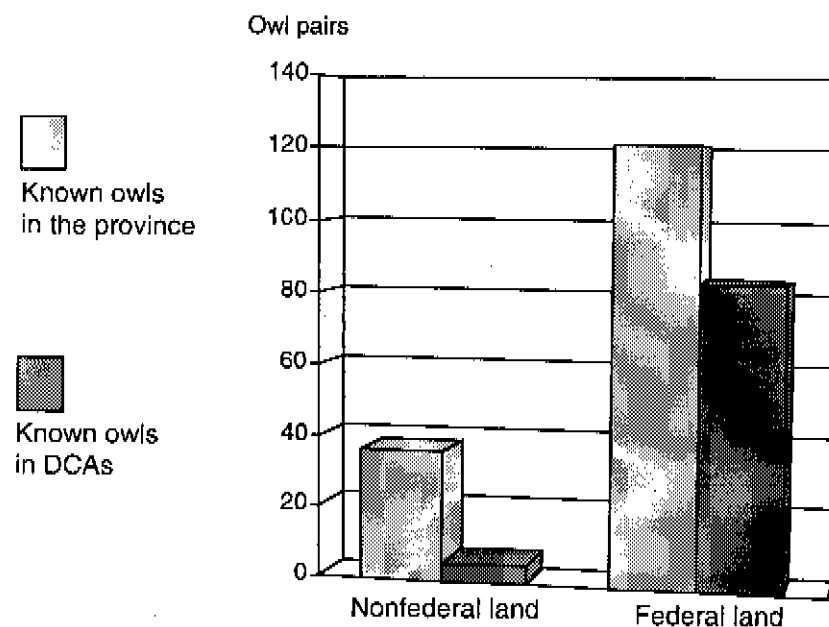


Figure 3.13. Known owl pairs in the eastern Washington Cascades province and in DCAs within the province.

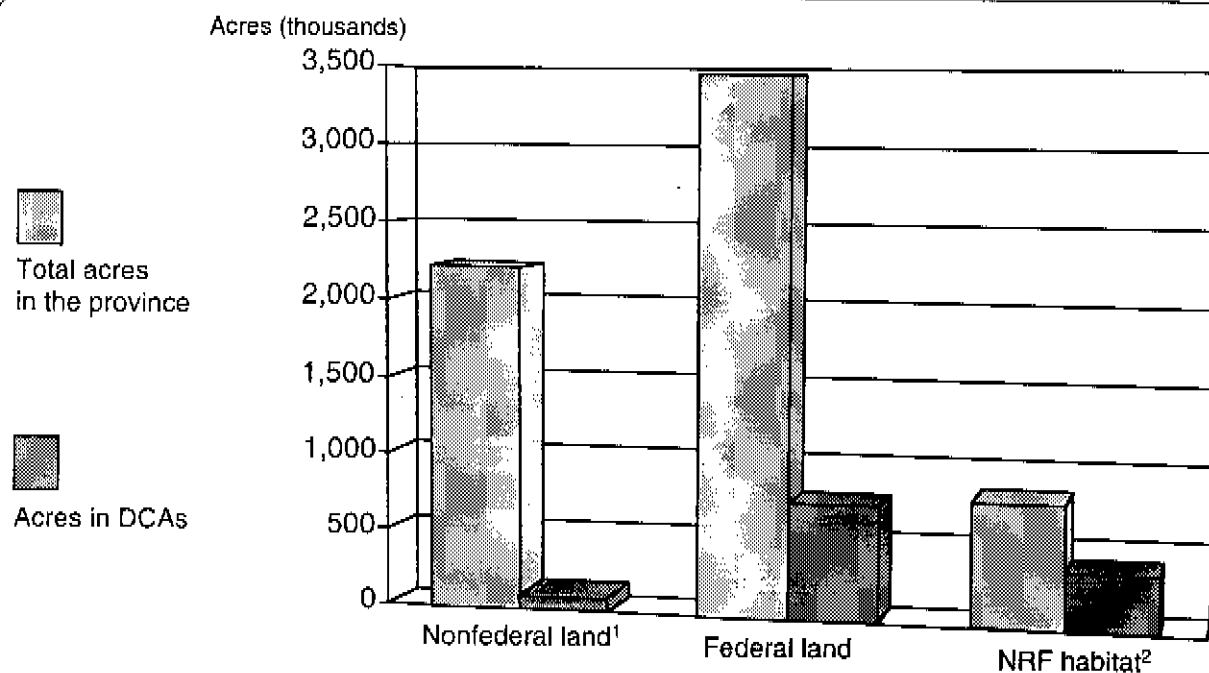


Figure 3.14. Acres in the eastern Washington Cascades province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

seven areas have been identified as needing prescription B or C. In most cases these federal matrix prescription areas correspond with areas of special management emphasis discussed for nonfederal lands.

In the Interstate 90 corridor, reserved pair areas are required to compensate for deficiencies in the DCA network (section III.C.2.). Population deficiencies in DCAs require reserved pair areas totaling 16,643 acres and five known owl activity centers. Habitat for these reserved pair areas also will alleviate the threat of impaired owl dispersal through this checkerboard ownership, and should be coordinated with nonfederal landowners.

Managed pair areas (prescription C matrix management) are located on federal land within high fire-risk mixed conifer and ponderosa pine forests of the province. Five areas are delineated where managed pair areas are recommended for all currently known spotted owls on federal land, and those discovered in the future. These areas are:

- Between WD-1 and WD-1N: three known activity centers to be protected,
- Among WD-16, WD-15, WD-12 and WD-14: seven known activity centers,
- Between WD-5 and WD-6: two known activity centers,
- Among WD-6, WD-21 and the eastern province boundary: three known activity centers,
- Among WD-7, WD-21 and WD-22: four known activity centers.

Based on these known owl activity centers, a total of 19 known activity centers and 108,176 acres would be included in prescription C managed pair areas.

Biological goals and implementation on nonfederal lands

Three areas are identified for special management emphasis on nonfederal lands. In all three cases, recommendations are made for nonfederal lands to augment federal management in addressing threats to owl populations.

In the Interstate 90 corridor area of checkerboard ownership. Habitat loss and north-to-south connectivity among DCAs are the main concerns. It is recommended that nonfederal lands provide nesting, roosting, and foraging habitat for spotted owls within or directly adjacent to federal DCAs WD-5, WD-6, WD-7, and WD-16. It is recommended that dispersal habitat be provided among these DCAs. The goal is to contribute to owl population stability within the DCAs. Managed suitable habitat is expected to provide characteristics necessary for roosting and foraging, but not necessarily for nesting. Some nesting habitat may be needed in the short term, especially since the DCAs are deficient in owl pairs.

Endangered Species Act prohibition of take currently is contributing to the objective of augmenting checkerboard DCAs in the Interstate 90 corridor. Nonfederal landowners currently are affected by prohibitions on take involving many owl sites in the general area identified for special management emphasis. Protective management as described in section III.C.3. could lead to more efficient conservation measures and improve achievement of recovery objectives. New forestry techniques already are practiced by some landowners in this area, and should contribute to achieving objectives within DCAs. State forest practices rules could be used to ensure protection of known owls. In some areas where there is adequate federal nexus, federal critical habitat designation could provide protection beyond that available through other means. Land exchange also may be a useful and accepted mechanism in these checkerboard ownership areas. Land purchase may be needed for small acreage landowners.

An additional recommendation to alleviate threats in the Interstate 90 corridor is to develop habitat on the L.T. Murray Wildlife Area to support a large cluster of owl pairs (more than 20 pairs) in conjunction with

habitat in DCA WD-16. Approximately 20,000 acres are needed to achieve this objective. The L.T. Murray Wildlife Area is owned by the State of Washington and most of the land is dedicated to wildlife habitat uses. Although there is little spotted owl nesting, roosting, or foraging habitat in the area now, development of habitat over time is possible. The recovery plan recommends that mixed conifer habitat in this area be managed to develop old-growth and other late successional forest characteristics. This will contribute to the recovery objective.

Checkerboard ownership north from WD-6 and extending to area surrounding and adjacent to WD-20, WD-21, and WD-22. In this area, the concerns and recommendations are the same as described for the Interstate 90 corridor.

Two other areas of special management emphasis are nonfederal lands between the Yakima Indian Reservation and federal DCAs (between WD-12 and the reservation, and between the reservation and WD-1). The recommendation for these areas is to provide dispersal habitat. Dispersal areas should be as continuous as feasible, and broad enough to allow a reasonable likelihood that owls will stay within them as they move between DCAs. In the southern area, this dispersal habitat will improve dispersal opportunities adjacent to the Columbia River Gorge.

Much of this area is currently in uneven-age management, which in many cases provides dispersal habitat and perhaps foraging habitat. Development of new forestry practices and uneven-aged management may improve the contribution to recovery. Protective management, as described in section III.C.3., could contribute to this objective. If new state forest practices regulations were developed, such regulations could contribute to this objective.

Oregon Coast Range Province

Province description

This province covers approximately 4.5 million acres in western Oregon between Washington and the Oregon Klamath province. Ownership is 57 percent private, 30 percent federal, and 13 percent state lands. The Grand Ronde and Siletz Indian Reservations lie within the province; contributions from these Indian lands are discussed in section II.C.8. Federal lands include the Siuslaw National Forest and portions of four BLM districts. BLM lands are distributed in a checkerboard ownership pattern through much of the province. Approximately 325 northern spotted owl pairs are known to occur in the province. Thirty-two percent of the pairs are in the southern portion of the province, south of Highway 38 primarily on BLM lands.

Severe threats to the spotted owl exist in this province including low and declining populations, little nesting, roosting, and foraging habitat (only 15 percent of the province), poor distribution of remaining owls and owl habitat, and high levels of predators. There is poor habitat and population connectivity both within the province and with adjoining provinces.

Four areas of special emphasis have been identified. Reduced habitat and poor population connectivity are problems in all four areas.

Tillamook/Astoria area. Forest stands in this area are primarily young and homogeneous due to past fires and logging. Federally owned lands comprise a small proportion of the ownership and are unlikely to make major contributions to recovery. Suitable habitat and owl populations are at extremely low levels.

Middle Oregon Coast (Highway 18 to Highway 34). Ownership in this area is primarily nonfederal. Currently, nesting, roosting, and foraging habitat is limited in the recommended DCAs, due to timber harvest. Habitat to support dispersal among the DCAs also is limited.

Eugene and Drain Corridor. Nesting, roosting, and foraging habitat has been reduced and fragmented in recommended DCAs, due to timber harvest. Habitat among the DCAs between the Oregon coast and the western Oregon Cascades is highly fragmented, thus reducing its suitability for dispersal.

Area south of Highway 38. Nesting, roosting, and foraging habitat is limited within recommended DCAs. Habitat for dispersal is limited among DCAs and between this province and the Oregon Klamath province, due to harvest patterns within areas of checkerboard ownership.

Biological goals and implementation on federal land

Seventeen DCAs are recommended for this province, with five DCAs meeting category 1 criteria (Tables 3.11 and 3.12). A total of 110 pairs of owls has been

Table 3.11. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Oregon Coast Range province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J. 5.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
OD-27	77,749	67	27,320	15	1	12	20
OD-28	70,663	69	26,720	19	5	15	20
OD-29	50,636	82	28,360	9	1	10	15
OD-30	59,934	57	15,760	14	4	10	12
OD-31	70,555	84	31,760	14	0	14	20
OD-32	39,894	75	15,000	5	0	5	10
OD-33	60,175	61	9,640	5	0	5	12
OD-34	50,661	49	24,600	7	0	7	15
OD-35	51,780	86	17,800	3	0	3	15
OD-36	70,212	76	9,720	3	0	3	18
OD-37	46,239	58	2,920	2	2	3	7
OD-38	8,942	54	1,240	1	0	1	1
OD-49	22,352	13	800	1	0	1	1
OD-50	51,050	17	240	2	2	2	4
OD-53	86,004	91	38,440	8	0	12	30
OD-54	8,509	58	2,640	2	0	1	2
OD-55	2,713	53	200	0	0	0	1
Totals:	828,068	69	253,160	110	15	104	203
Totals for all lands in province:			437,494	269	57		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details. This may be smaller than the current known number where populations are adjusting to rapidly changing habitat conditions.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.12. Summary comments on the designated conservation area (DCA) network in the Oregon Coast Range province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
OD-27, OD-31, OD-53	These category 1 DCAs currently contain fewer than 20 owl pairs, but have a future capability of supporting more than 20 owl pairs, based on federal habitat.
OD-28	This category 1 DCA currently supports more than 20 owl pairs, but requires nonfederal contribution to do so. Future federal habitat capability is for 20 owl pairs.
OD-36	This category 1 DCA currently contains fewer than 20 owl pairs. However, it has a future capability of supporting more than 20 owl pairs with a relatively small nonfederal contribution.
OD-30 and OD-33	These are category 2 DCAs with less than 20 owl pairs, based on federal habitat only. If significant nonfederal contributions are obtained, the areas are capable of supporting more than 20 owl pairs.

located on federal lands within these DCAs between 1986 and 1990. This represents approximately 40 percent of the 268 pairs located on all federal land during that same period (Figure 3.15). The DCAs contain about 58 percent of the nesting, roosting, and foraging habitat identified on federal land (Figure 3.16).

Federal matrix management in the Oregon Range Coast province will require prescription A and prescription B management areas. Because of the low number of pairs within DCAs north of Highway 38, an estimated 57 reserved pair areas (prescription B) should be established to supplement the DCAs. Three additional reserved pair areas should be established southeast of OD-27 to supplement the population in that DCA. The remainder of the federal matrix in this province should be managed for dispersal habitat under matrix prescription A (section III.C.2.). Residual habitat areas of 100 acres each should be established for all known and future-discovered activity centers up to a density of eight areas per township.

With the addition of the reserved pair areas, approximately 60 percent of all known pairs on federal lands within the province will be protected by this plan. Nearly all known pairs on federal lands north of Highway 38 will be protected.

Biological goals and implementation on nonfederal land

General goals for nonfederal lands are to (1) provide nesting, roosting, and foraging habitat within federal DCAs with checkerboard ownership; (2) provide dispersal habitat in all special management emphasis areas; (3) encourage cooperative management on state lands to provide nonfederal clusters of owls and dispersal habitat among clusters; and (4) develop a cooperative habitat management plan for the Elliott State Forest. Specific objectives and implementation approaches are described later.

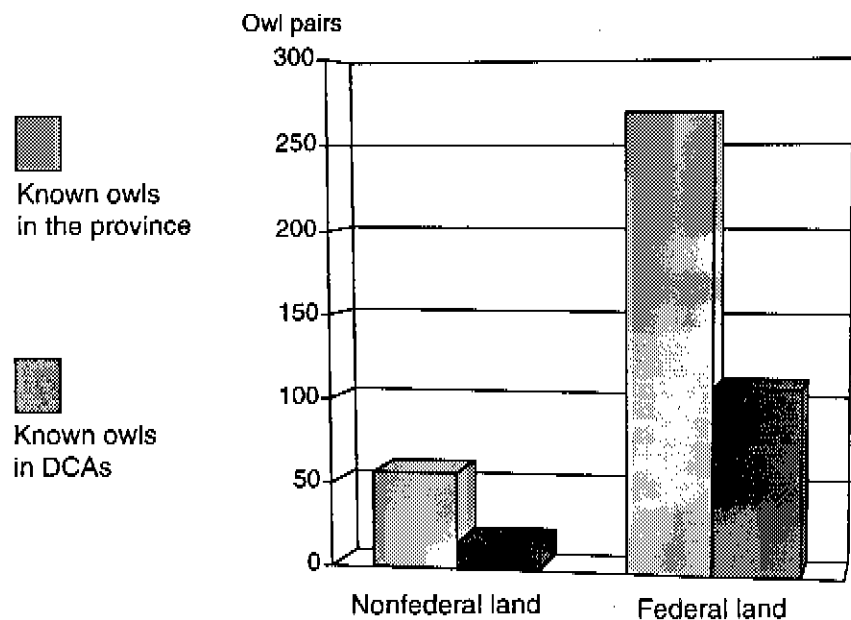


Figure 3.15. Known owl pairs in the Oregon Coast Range province and in DCAs within the province.

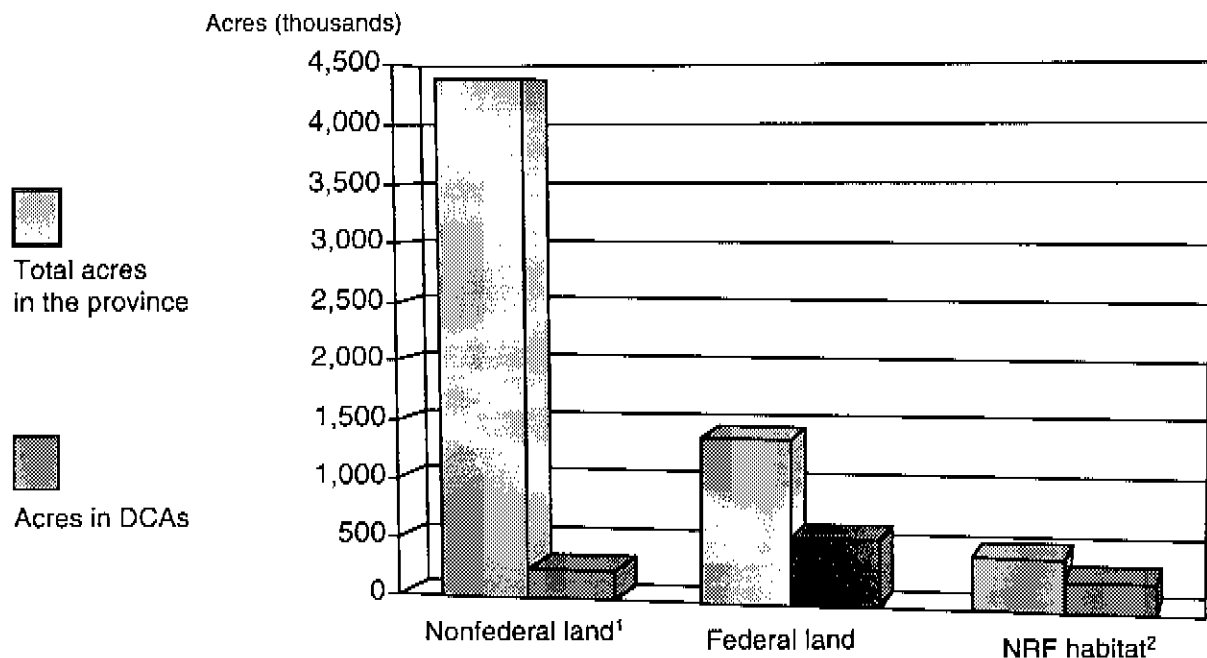


Figure 3.16. Acres in the Oregon Coast Range province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

Tillamook/Astoria area. Provide supplemental pair areas to protect currently known and future-discovered pairs and manage for clusters of pairs over the long term. DCA OD-50 has been recommended in this area, using federal lands as a basis for one of these clusters. Provide dispersal habitat among these clusters.

Achievement of recovery objectives in this area will depend largely on contributions from nonfederal lands. Fourteen spotted owl pairs or singles have been located in the Tillamook/Astoria area. Prohibition against take of these spotted owls and future-discovered spotted owls will make some contribution to accomplishing objectives. Most of these sites are clustered on the western and northern sides of the Clatsop and Tillamook State Forests, where there are mature stands that survived the multiple forest fires that occurred from the 1930s until early 1950. The state manages these lands in trust for the fiduciary benefit of the local counties. Land exchange or purchase may be necessary to meet the recovery objective to establish clusters and assure long term recovery.

Middle Oregon Coast (Highway 18 to Highway 34). The province recovery objectives on nonfederal lands are to provide nesting, roosting, and foraging habitat in the DCAs with checkerboard ownership, and to provide dispersal habitat among these DCAs. The DCAs needing supplemental habitat include OD-33, OD-37, OD-38, and OD-49. The recommendation for dispersal habitat applies to nonfederal land throughout this area. The objective of providing habitat within these DCAs is to meet, in conjunction with habitat on federal land, the owl population objectives for the DCAs. Some opportunity may exist to negotiate for the best combinations of contributions from nonfederal landowners since they are currently affected by the prohibition against taking spotted owls. Scattered state lands occur in this area, managed under trust for the counties or for the State Land Board (Common School Trust). The VanDuzer Corridor along Highway 18 could provide some contribution to habitat needs. Federal land exchange or purchase may be necessary to meet the recovery objectives.

Eugene and Drain Corridor. Provide nesting, roosting, and foraging habitat in DCAs located in checkerboard ownership, and provide dispersal habitat among these DCAs. These include DCAs OD-29, OD-30, OD-31, OD-54, and OD-55. Nonfederal landowners currently are affected by the prohibition against take in this area.

Area south of Highway 38. In areas of checkerboard ownership, provide suitable nesting, roosting, and foraging habitat in DCAs OD-27 and OD-28 and provide dispersal habitat among all DCAs and to the province boundaries. Nonfederal landowners currently are affected by the prohibition against take in this area, so some opportunity exists to negotiate for the best combination of contributions from them.

An additional objective is to develop a cooperative habitat management plan for the Elliott State Forest. Thirty-eight spotted owl pairs or resident singles have been located in this forest. As a result, the state forest is currently contributing to recovery due to prohibitions against take. Conservation planning as described in section III.C.3. for the Elliott State Forest could lead to more efficient conservation measures and improve the likelihood of achieving recovery objectives. State lands also are affected by Oregon's Endangered Species Act. A conservation plan could be used to comply with the state's Endangered Species Act on state-owned lands. In addition, the Mill Creek and Umpqua River drainages have been designated by the State Land Board as areas that will be

managed for nontimber values. This management will provide some contribution toward recovery.

In general, there are several means that can be considered for accomplishing recovery objectives on nonfederal lands. Conservation planning (section III.C.3.) could lead to more efficient conservation measures and could help achieve some of these recovery goals. Conservation plans on state lands could be used to comply with the state's Endangered Species Act on state-owned lands and provide an incentive for conservation planning. The recovery plan should be used to help guide compliance with Oregon's Endangered Species Act programs on state lands and provide an incentive for conservation planning. To the extent that the recovery plan and the state Endangered Species Act programs can be made consistent, coordination between them will be improved.

In checkerboard ownership areas where a federal nexus may exist, critical habitat designation could provide additional protection. Federal land exchange or purchase might be necessary to meet the recovery objective. The Oregon Department of Forestry is implementing a Sustainable Forestry Program on state lands that would yield additional benefits to wildlife by providing more snags, down material, and riparian zone protection. Other voluntary contributions on private lands could provide additional benefits.

Western Oregon Cascade Province

Province description

This province is the largest in Oregon (6.9 million acres), contains more documented owl pairs (925), and has the largest acreage of nesting, roosting, and foraging habitat (approximately 1,918,000 acres). Land ownership throughout the province is mixed, with private lands generally at lower elevations. National forest land extends almost the length of the province and includes the Mt. Hood, Willamette, Umpqua, and Rogue River National Forests. BLM lands, generally occurring in checkerboard ownerships with private lands, are located at lower elevations on the western portion of the province. These BLM lands include parts of the Salem, Eugene, Roseburg, and Medford Districts. State lands are present in the northern portion of the province in the Santiam State Forest.

Habitat has been fragmented by timber harvest throughout the province. However, the fragmentation is less severe at middle elevations than at lower elevations. Higher elevations (above 4,500 feet) are naturally unsuitable as spotted owl habitat. This landscape has resulted in current owl distribution generally in the mid-elevation zone. Owls are generally distributed continuously through national forest lands at these middle elevations with the exception of the checkerboard ownership lands in the Santiam drainage. A few owls occur at lower elevations on private lands where habitat remains.

As discussed in Status and Threats (section II.B.5.), owl management concerns in the province are varied. These concerns include habitat loss and fragmentation (71 percent of the province is considered unsuitable habitat due to timber harvest); declining populations; and poor population connectivity with adjacent provinces due to checkerboard ownership, timber harvest, and the Columbia River Gorge.

Two areas of special management emphasis have been identified. In each area, there are two main concerns. The first is the pattern of checkerboard ownership within DCAs. Federal lands alone in these DCAs would be inadequate to fully meet the DCA objectives. The second main concern is poor population

connectivity between key DCAs. This results in weak linkages between the western Oregon Cascades province and the Oregon Coast Range and California Cascades provinces. Specific concerns for these areas of special management emphasis follow.

Area between the Oregon Coast Range and Oregon Klamath provinces and the western Oregon Cascades province (this includes OD-11, OD-12, OD-17, OD-39, OD-56, OD-57, OD-58). Dispersal habitat in this area has been reduced and fragmented due to timber harvesting, which reduces the likelihood of successful owl dispersal. In addition, most of these DCAs consist of checkerboard ownership, and federal land in these DCAs is generally not adequate to fully accomplish the DCA objectives.

Area south of OD-19. Several concerns exist; habitat among DCAs OD-19, OD-40, and the California provinces has been reduced and fragmented by timber harvest; there is a compounding risk of habitat loss from fire (Appendix F). Also, checkerboard ownership in DCAs reduces capability to achieve DCA objectives solely on federal lands.

Biological goals and implementation on federal lands

Using the design criteria for the DCA network and future habitat capability estimates, 17 category 1 DCAs and five category 2 DCAs are recommended for this province (Tables 3.13 and 3.14). These areas currently contain 413 documented owl activity centers (357 pairs and 56 territorial singles). The pairs included on federal lands in DCAs represent approximately 41 percent of pairs (Figure 3.17) located on federal lands in this province in the last 5 years. The DCAs contain about 42 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province (Figure 3.18). The majority of these DCAs are in national forests; eight occur on BLM lands.

Generally, federal matrix management will follow prescription A, with the federal landscape meeting the 50-11-40 rule and residual habitat areas established around activity centers outside of DCAs, up to a density of eight areas per township. The exception to this general matrix management is the need for one reserved pair area, west of OD-19 to supplement the known pairs in this DCA.

Biological goals and implementation on nonfederal lands

As with other provinces, the recommendations for nonfederal lands focus on the areas of special management emphasis. These areas and concerns about them are:

Area between the Oregon Coast Range and Oregon Klamath provinces and the western Oregon Cascades province (this includes OD-11, OD-12, OD-17, OD-39, OD-56, OD-57, OD-58). Within DCAs in checkerboard ownership in the areas of special management emphasis, provide habitat suitable for nesting, roosting, foraging, and dispersal. This will include DCAs OD-12, OD-17, OD-39, OD-40, OD-56, OD-57, and OD-58. The objective of providing habitat within the DCAs is to fully meet, in conjunction with habitat on federal land, the objectives for the DCAs.

In addition to providing nesting, roosting, and foraging habitat as needed, nonfederal lands should provide dispersal habitat among the DCAs in these areas of special management emphasis. In the portion of the western Oregon Cascades that connects to the southern Oregon Coast, dispersal habitat should generally be provided within an area that encompasses OD-11, OD-12, OD-58, OD-57, OD-56, and OD-39.

Area south of OD-19. In the southern portion of the western Oregon Cascades, dispersal habitat should be provided in a band that generally connects OD-19, OD-20, and OD-40.

Currently, the federal Endangered Species Act requirements prohibiting take are contributing to partial fulfillment of the nonfederal recommendations in the province, but some of the guidelines do not contribute effectively to the goal of providing dispersal habitat. Protective management (section III.C.3.) could lead to more efficient conservation measures.

Federal land exchange or purchase may be necessary to meet the recovery objectives for nonfederal land in this province. Land exchange would be

Table 3.13. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the western Oregon Cascades province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.6.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³		Current Projected Federal ⁴	Future Projected Federal ⁵
				Federal	Nonfed		
OD-1	148,299	99	95,280	9	0	30	42
OD-3	111,716	100	60,560	19	0	23	35
OD-4	98,610	91	50,840	13	0	20	30
OD-5	80,982	95	38,560	23	0	22	30
OD-6	81,251	93	49,520	18	0	25	30
OD-7	67,248	94	40,280	23	0	23	30
OD-8	103,792	100	78,480	21	0	25	28
OD-9	84,370	100	40,480	25	0	25	33
OD-10	80,087	100	43,600	16	0	20	30
OD-11	65,444	93	34,000	22	0	20	25
OD-12	89,741	57	32,280	29	0	20	23
OD-13	92,956	97	56,160	27	0	25	35
OD-14	82,090	96	52,240	29	1	25	33
OD-15	88,789	91	45,240	16	0	18	25
OD-17	55,174	58	20,320	24	4	13	20
OD-18	66,504	96	28,175	20	0	18	25
OD-19	86,433	93	39,365	14	0	14	23
OD-39	12,504	55	920	2	0	1	1
OD-40	43,122	69	8,440	6	0	5	10
OD-56	2,960	59	360	0	0	0	1
OD-57	2,610	61	440	0	0	0	1
OD-58	2,648	55	560	1	0	1	1
Totals:	1,547,330	92	816,100	357	5	373	511
Totals for all lands in province:			1,942,336	876	49		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.14. Summary comments on the designated conservation area (DCA) network in the western Oregon Cascades province. (Section III.C.2.a. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
OD-5, OD-7, OD-8 OD-9, OD-11, OD-12, OD-13 and OD-14	These category 1 DCAs each currently support 20 or more pairs of owls.
OD17 and OD-18	These category 1 DCAs each currently support 20 or more pairs of owls but require both federal and nonfederal land to do so. In the future, they will be able to support 20 pairs solely on nonfederal lands.
OD-1, OD-3, OD-4 OD-6, OD-10, OD-15 and OD-19	These category 1 DCAs are currently estimated to contain fewer than 20 pairs of owls. Each DCA has the potential to increase up to 20 pairs.
OD-40	This DCA is recommended to provide population connectivity to the California Cascades province. It is estimated to support 14 pairs of owls in the future.
OD-39, OD-56, OD-57,	These DCAs provide an important linkage between the western Oregon Cascades province and the Oregon Coast Range province.

extremely expensive and depend on legal restrictions. In checkerboard ownership areas where a federal nexus exists, designating the land as critical habitat might provide additional protection.

Some state lands do not lie within the areas of special management emphasis, but are contributing to more general recovery goals in the province. The southern portion of Oregon's Santiam State Forest lies between DCAs OD-4 and OD-6. This state land is managed in trust for the fiduciary benefit of the local counties and currently is managed to provide for owl dispersal between these DCAs. Voluntary contributions by the state's Sustainable Forestry Program and private landowners could provide additional benefits. Silver Falls State Park is another parcel of state land which contributes to recovery by providing nesting, roosting, and foraging habitat.

The recovery plan should be used to help guide compliance with Oregon's Endangered Species Act programs on state lands and provide an incentive for conservation planning. To the extent that the recovery plan and the state Endangered Species Act programs can be made consistent, coordination between them will be improved.

Eastern Oregon Cascades Province

Province description

The eastern Oregon Cascades province extends from the Columbia River to the California border but occupies only a narrow area between Highway 97 and the

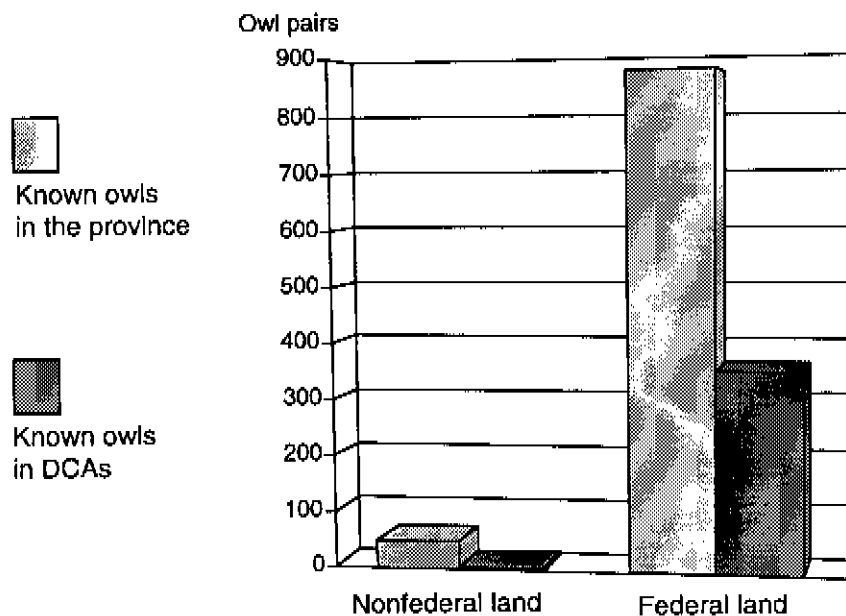


Figure 3.17. Known owl pairs in the western Oregon Cascades province and in DCAs within the province.

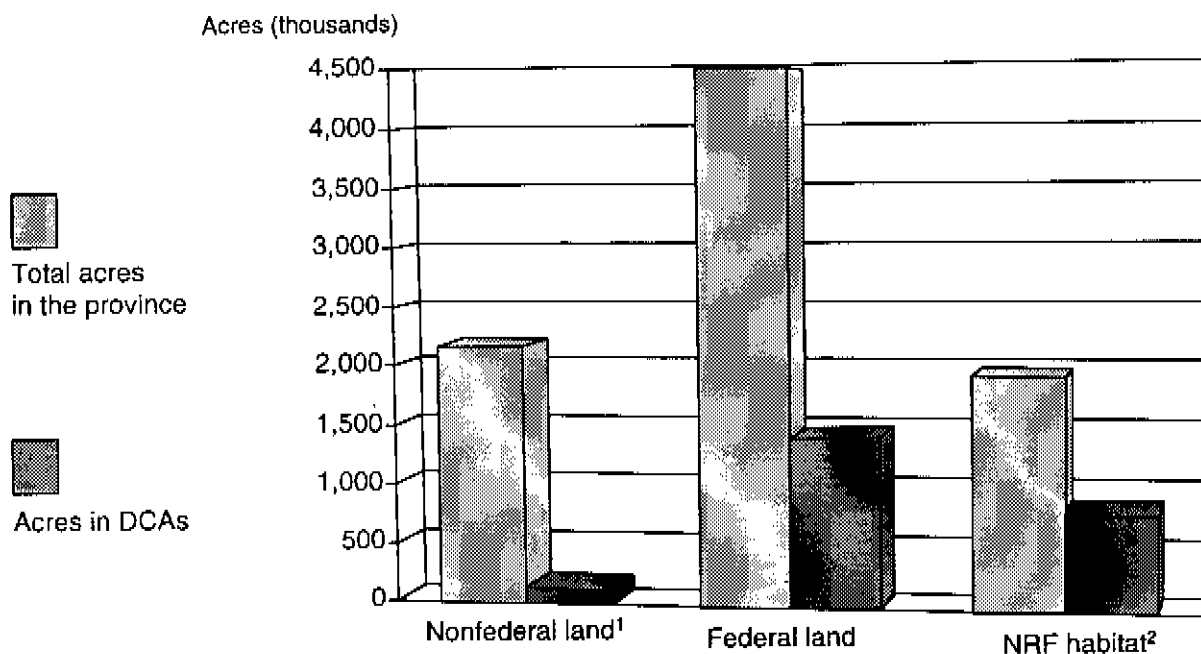


Figure 3.18. Acres in the western Oregon Cascades province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

crest of the Cascade Mountains. There were approximately 163 owl pairs located in the province between 1986 and 1990, representing about 9 percent of the known state population. The province consists primarily of federal land, including parts of the Mt. Hood, Deschutes, and Winema National Forests, Crater Lake National Park, and the Lakeview District of the BLM. Nonfederal land includes private and state lands primarily south of the Winema National Forest. This nonfederal land includes one area of special management emphasis.

The area between OD-19 and the California border. The area from DCA OD-19 to the California border has been identified as an area for special management emphasis, where BLM, private, and state lands are intermingled. Owl habitat has been reduced and fragmented in this area, resulting in poor population connectivity with the California Cascades province. A further concern is the risk of habitat loss from fire.

Serious threats to the spotted owl population in the province include poor distribution as a result of low owl density and fragmented habitat, and risk of catastrophic habitat destruction due to wildfire (section II.B. and Appendix F).

The Warm Springs Indian Reservation occurs within this province. Recovery contributions provided by the Confederated Tribes of the Warm Springs are described in section II.C.8.

Biological goals and implementation on federal lands

One category 1 DCA and 12 category 2 DCAs are recommended in this province (Tables 3.15. and 3.16.). Approximately 62 pairs of owls have been located on federal lands in these DCAs. This represents about 42 percent of the 146 pairs located on all federal lands in the province (Figure 3.19). Approximately 26 percent of the nesting, roosting, and foraging habitat identified on federal lands in the province is located within the DCAs (Figure 3.20). The majority of federal forest land outside the DCAs should be managed under matrix prescription A (section III.C.2.). This includes establishing residual habitat areas around activity centers in the matrix up to a maximum density of six areas per township. However, in the portion of the province in the Deschutes National Forest, it is recommended that reserved pair areas (matrix prescription B) be established around all currently known and future-discovered activity centers in the matrix.

Biological goals and implementation on nonfederal lands

The recovery objective for nonfederal lands is to provide habitat to improve dispersal conditions in the area of special management emphasis.

Area between OD-19 and the California border. This area consists of checkerboard ownership, but is dominated by nonfederal lands. Nonfederal contributions should work in conjunction with federal habitat in this area to provide for dispersal between the eastern Oregon Cascades and the California Cascades. Where ecological potential exists, nesting habitat also could be provided in this area to improve the likelihood of dispersal among provinces. The prohibition on take is unlikely to make substantial contributions toward meeting these objectives because few owl sites are known on nonfederal lands in this area.

The recovery plan should be used to help guide compliance with Oregon's Endangered Species Act programs on state lands and provide an incentive for

conservation planning. To the extent that the recovery plan and the state Endangered Species Act programs can be made consistent, coordination between them will be improved.

Oregon Klamath Province

Province description

The Klamath province starts in the southern third of Oregon and extends south about 250 miles through most of northern California. The topography of the province is characterized by the mountainous terrain of the Klamath and Siskiyou mountains. For the purposes of the recovery plan, the Klamath has been separated into the Oregon Klamath province and the California Klamath province. This discussion focuses on the Oregon Klamath province.

The northern spotted owl population in the province is the major population link between the Oregon Coast Range and western Oregon Cascades provinces. It provides the primary connection between spotted owl populations in Oregon and California. The province contains approximately 390 known pairs of spotted owls. Approximately 360 of these are located on federal lands. Na-

Table 3.15. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the eastern Oregon Cascade province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.7.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³		Current Projected Federal ⁴	Future Projected Federal ⁵
				Federal	Nonfed		
OD-2	74,558	99	51,200	21	0	21	26
OD-41	9,855	90	4,560	1	0	1	2
OD-42	20,000	100	8,520	4	0	4	5
OD-43	29,367	98	7,840	5	0	5	6
OD-44	16,532	100	8,560	4	0	4	4
OD-45	18,256	99	4,240	1	0	1	3
OD-51	28,601	99	9,320	7	0	7	7
OD-59	41,858	95	20,783	13	0	13	18
OD-60	3,023	100	480	1	0	1	1
OD-61	3,001	100	720	1	0	1	1
OD-62	2,705	100	1,400	1	0	1	1
OD-63	3,013	71	800	1	0	1	1
OD-64	3,063	100	520	1	0	1	1
OD-65	3,028	82	760	1	0	1	1
Totals:	256,860	98	119,703	62	0	62	77
Totals for all lands in province:			455,156	146	17		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.16. Summary comments on the designated conservation area (DCA) network in the eastern Oregon Cascades province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
OD-2	This category 1 DCA, entirely on federal lands, supports more than 21 owl pairs. It has a future capability of supporting 26 owl pairs.
OD-41 through OD-45, OD51, and ODA-59 through OD-65	The scattered distribution of owls and owl habitat on the east side of the Cascades prevented delineating large DCAs capable of supporting 20 owl pairs either now, or in the future.

tional forests and BLM lands compose the majority of the province. Unlike the California Klamath province, few spotted owl activity centers are known on private lands, though 34 percent of the province is in private ownership. These private lands are located at lower elevations intermixed with BLM lands in a checkerboard ownership pattern. A small amount of state forest land is located in the province, including some state land within the perimeters of recommended DCAs. Despite the mixed ownership in the province, most suitable habitat currently exists on federal lands.

Serious threats to the owl population in the Oregon Klamath province include loss and fragmentation of habitat due to timber harvest and fires (Appendix F); a declining population as demonstrated in density study areas (Appendix C); and weak population connectivity within the province and with adjacent provinces because of poor habitat conditions in areas of checkerboard ownerships.

The area of checkerboard ownership in the north and east half of this province has been identified as a special emphasis area for recommendations on non-federal lands.

Area of checkerboard ownership in the north and east half of the province: This area is of concern because: 1) nesting, roosting, and foraging habitat has been fragmented by timber harvest in checkerboard ownership areas; 2) dispersal habitat has been reduced and fragmented by timber harvest; and 3) the risk of habitat loss to fire is high.

Biological goals and implementation on federal lands

Using the design criteria for the DCA network, nine DCAs are recommended within this province (Tables 3.17 and 3.18). Eight of the DCAs satisfy the criteria for category 1 DCAs. Only OD-52 does not. Two of the category 1 DCAs, OD-20 and OD-22, extend into California. Conversely, part of one California Klamath province DCA (CD-5) extends slightly into Oregon. (The data for these DCAs that cross state boundaries are presented in the province that includes the majority of the land.)

Currently there are 115 known pairs and 67 territorial singles on federal lands within the nine DCAs. The DCAs contain about 32 percent of the known pair

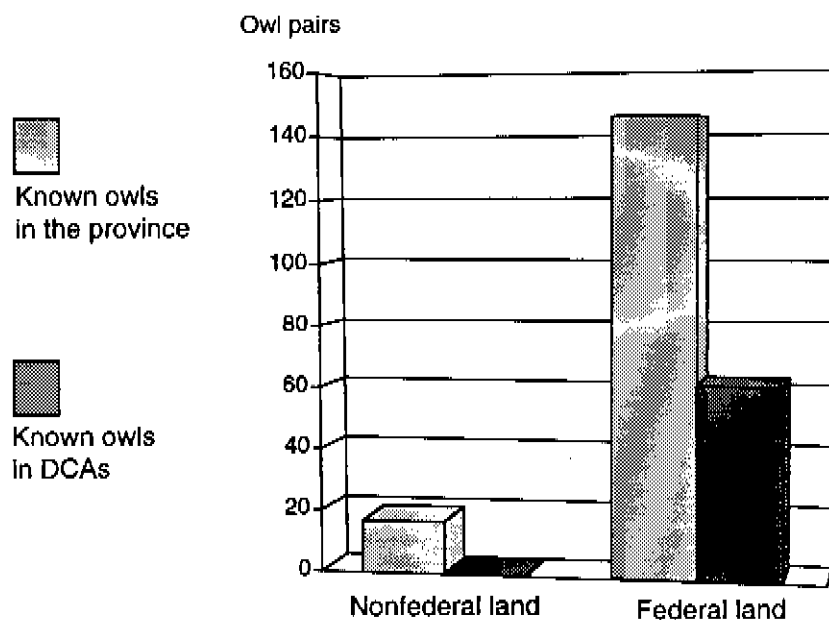


Figure 3.19. Known owl pairs in the eastern Oregon Cascades province and in DCAs within the province.

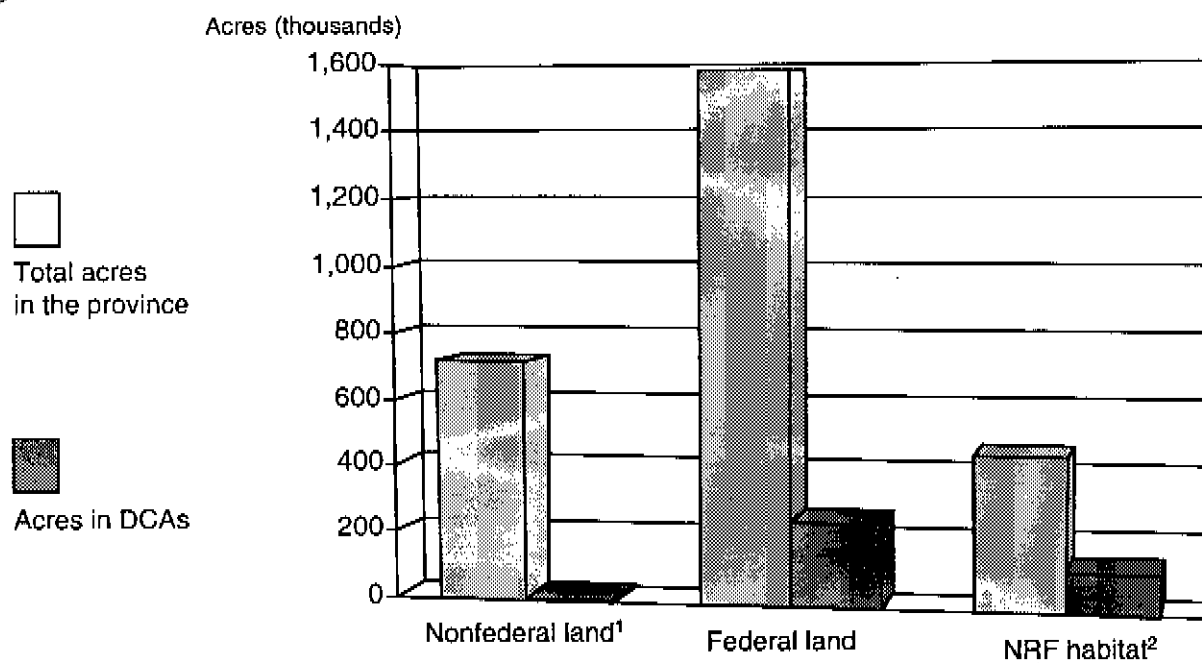


Figure 3.20. Acres in the eastern Oregon Cascades province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

sites on federal lands (figure 3.21). This is a relatively low percentage of known protected pairs compared to other provinces. When habitat has recovered on federal lands within these DCAs, the DCAs are expected to support 205 pairs of spotted owls. The DCAs contain about 53 percent of the nesting, roosting, and foraging habitat located on federal lands in the province (Figure 3.22).

Generally, federal matrix forests should be managed under prescription A, providing dispersal habitat on lands outside of DCAs following the 50-11-40 guideline. As part of this prescription, residual habitat areas of 100 acres should be delineated around all known and future-discovered owl activity centers in the matrix up to a maximum density of 10 areas per township.

In addition to prescription A, two zones are recommended for matrix prescription B. Reserved pair areas will be established in these locations to supplement the DCA network where it is deficient. Four reserved pair areas will be established around owl activity centers east and south of OD-21. One additional reserved pair area will be established west of OD-20.

Biological goals and implementation on nonfederal lands

A large area in the province has been identified for special management emphasis.

Table 3.17. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the Oregon Klamath province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J. 8.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
OD-16	85,379	49	21,840	23	0	17	22
OD-20	65,225	94	19,400	15	0	14	23
OD-21	78,086	73	28,360	13	0	11	20
OD-22	67,047	96	24,560	19	0	18	23
OD-23	130,447	99	52,840	7	0	22	30
OD-24	74,770	93	39,760	6	0	15	22
OD-25	71,133	90	37,000	16	1	20	25
OD-26	86,684	52	22,160	14	7	15	15
OD-52	40,654	93	21,640	2	0	13	18
CD-5 Data for this DCA are displayed in the California Klamath section							
Totals:	699,425	82	267,560	115	8	145	198
Totals for all lands in province:				501,872	358	29	

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.18. Summary comments on the designated conservation area (DCA) network in the Oregon Klamath province. Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.

Designated Conservation Area	Comments
OD-16	This category 1 DCA currently supports more than 20 pairs of owls but requires both federal and nonfederal lands to do so. In the future, it is projected to be able to support at least 20 pairs solely on federal land.
OD-20 through OD-25	These category 1 DCAs currently contain fewer than 20 known pairs of owls. Each has the potential to increase to at least 20 pairs.
OD-26	This DCA currently supports more than 20 known pairs of owls but requires both federal and nonfederal lands to do so. If some nonfederal contributions are maintained, it will continue to support at least 20 pairs.
OD-52	This category 2 DCA includes low elevation habitat and provides distribution of the network into the northwest corner of the province.

All checkerboard lands in the north and east portions of the province. Two recommendations are made:

- 1) Within the perimeter of DCAs OD-16, OD-21, and OD-26, provide nesting, roosting, and foraging habitat. The objective of providing habitat within these DCAs is to meet, in conjunction with habitat on federal land, the objectives for DCAs. The DCAs currently contain relatively good numbers of owl pairs, but nonfederal habitat is needed to perpetuate these pairs.
- 2) Provide dispersal habitat on nonfederal lands, especially among DCAs OD-16, OD-24, OD-25, and OD-26, and between OD-26 and OD-27 in the adjacent Oregon Coast Range province. The objective of providing this dispersal habitat is to help meet, in conjunction with habitat on federal land, the objectives for owl dispersal among the DCAs.

Currently, Endangered Species Act requirements prohibiting take are contributing to partial fulfillment of these nonfederal recommendations in the province. Some of the guidelines in the act do not effectively address the recommendations by providing dispersal habitat. Conservation planning and protective management (section III.C.3.) could lead to more efficient conservation measures for achieving some of these province recovery goals.

The recovery plan should be used to help guide compliance with Oregon's Endangered Species Act programs on state lands and provide an incentive for conservation planning. To the extent that the recovery plan and the state Endangered Species Act programs can be made consistent, coordination between them will be improved.

There is very little state land within the area of special management emphasis, but on these lands the Oregon Department of Forestry is implementing a Sustainable Forestry Program on state lands that would yield additional benefits to wildlife by providing more snags, down material, and riparian zone protection.

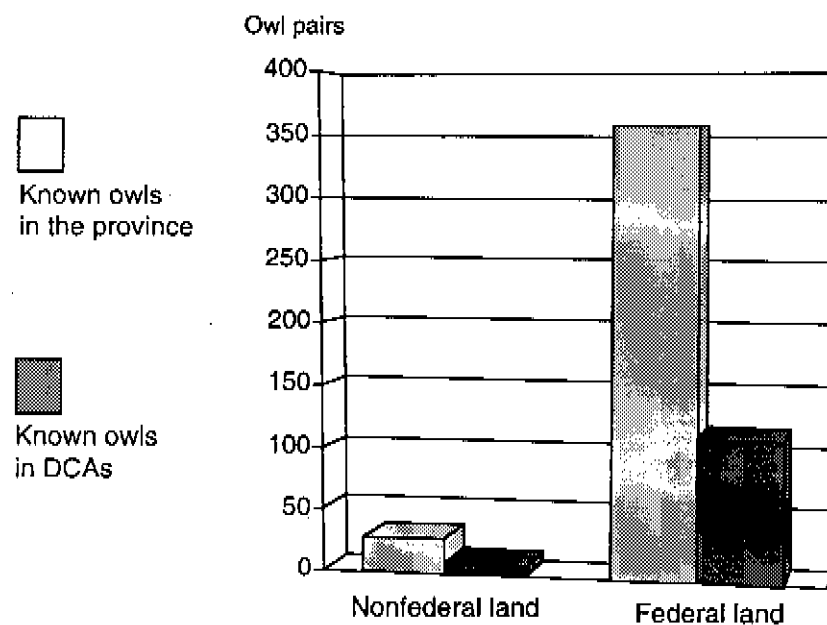


Figure 3.21. Known owl pairs in the Oregon Klamath province and in DCAs within the province.

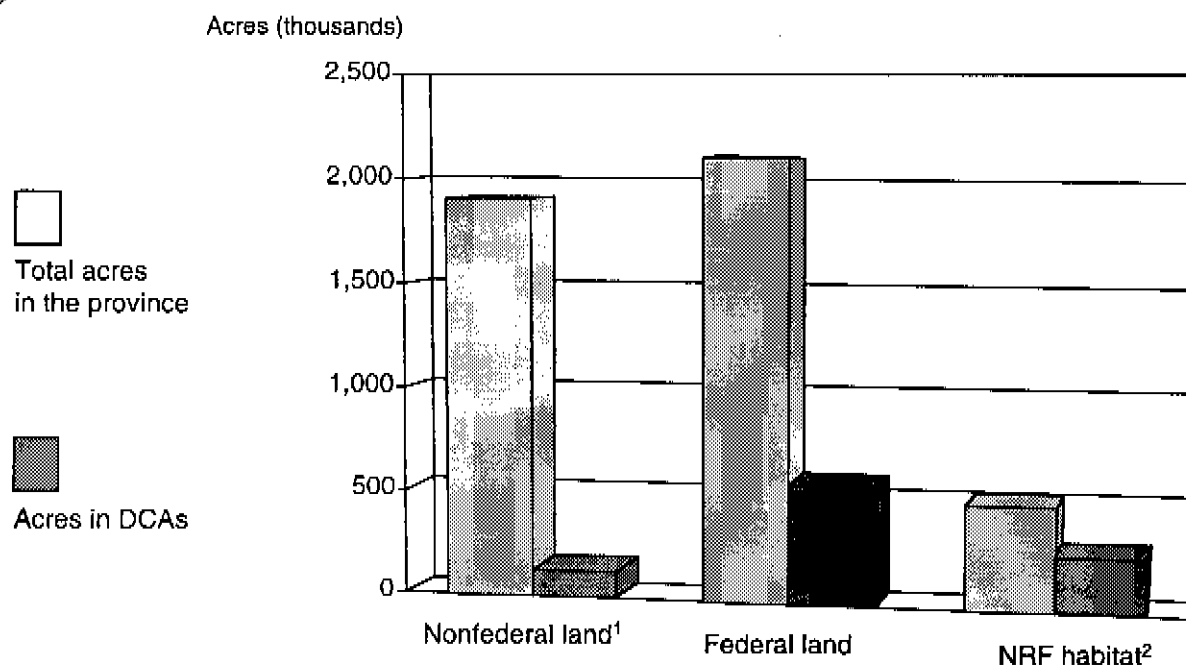


Figure 3.22. Acres in the Oregon Klamath province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

In checkerboard ownership areas where a federal nexus may exist, critical habitat designation could provide additional assurance of accomplishment of province recovery objectives. Federal land exchange or purchase might be necessary to meet these objectives in some areas.

The following province narratives for California are written in detail, to reflect current conservation planning efforts. Since December 1990, California landowners, forestry associations, environmental interests, scientists, and federal and state agencies have been participating in section 10 conservation planning (see section II.C.5.) The following descriptions of biological goals and implementation options are derived from the ongoing conservation planning efforts. The narratives also mention habitat conservation plans (HCPs) that have been, or are being prepared, by industrial forest owners in California.

California Coast Province

Province description

The California Coast province extends from the Oregon border to San Francisco Bay and from the ocean to the western border of national forest lands. The coastal portion of the province encompasses the majority of the redwood forest habitat type (Appendix B). Inland forests are Douglas-fir and mixed Douglas-fir/hardwood types, the latter often interspersed with chaparral and grasslands. Most forestland is in industrial or nonindustrial private ownership. Federal land in the province includes two national parks, a BLM conservation area, and a small portion of the Six Rivers National Forest.

The Round Valley Indian Reservation occurs within the California Coast province; recovery contributions by the Covelo tribes are described in section II.C.8.

Approximately 35 percent of the northern spotted owl's range and 30 percent of its known population in California are in the California Coast province. Owl populations are relatively high, with 450 known historic activity centers (11 percent on federal lands); pairs have been verified at 188 of these locations during the past 5 years.

Major threats in the province are the rate of habitat loss, particularly in the redwood zone, the low level of suitable Douglas-fir habitat, and the isolation of two populations at the southern end of the range of the subspecies (section II.B.6.).

Approximately 80 percent of the known spotted owl population in the province is on nonfederal lands. If those owls were extirpated, the remaining populations on federal lands would be too small and scattered to be self-sustaining. The spotted owl populations on federal lands south of northern Humboldt County likely would be extirpated, and this loss in turn would affect populations in the southern end of the adjoining California Klamath province, where owl density and amount of habitat are already low.

Biological goals and implementation on federal lands

Lack of federal land ownership in this province limits the recovery potential. As a result, no category 1 DCAs can be delineated in the province. However, 28 category 2 DCAs are recommended (Table 3.19., Table 3.20.). The larger DCAs are in national parks; the remaining DCAs are in the BLM conservation area and other BLM land. BLM parcels are included in smaller category 2

DCAs, often combined with adjacent state park lands. Eleven of these parcels might be consolidated into three groups, one of which could be a category 1 DCA. The DCAs contain approximately 50 percent of the owl pairs known to occur on federal lands in the province (Figure 3.23).

Table 3.19. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California Coast province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.9.)

DCA Ident. Number	Acreage		NRF Habitat Federal ²	Owl Pairs			
	Total	Percent Federal Land ¹		Known Owls ³		Current Projected Federal ⁴	Future Projected Federal ⁵
				Federal	Nonfed		
CD-47	32,388	42		1	0	2	3
CD-48	80,250	83		0	0	10	14
CD-50	38,455	84		2	0	10	12
CD-52	73,644	57		1	0	11	11
CD-53	8,306	47		0	0	2	2
CD-54	1,558	63		1	0	1	1
CD-56	2,272	100		3	0	3	3
CD-57	6,574	38		0	0	1	3
CD-58	1,266	90		0	0	1	2
CD-59	5,340	52		0	0	3	4
CD-60	2,899	58		0	0	1	3
CD-61	4,576	59		1	0	1	3
CD-62	2,676	52		0	0	1	2
CD-63	2,970	77		0	0	1	3
CD-65	10,676	91		1	0	1	2
CD-66	12,907	58		0	0	1	5
CD-67	8,090	53		0	0	0	2
CD-69	2,979	76		0	0	1	2
CD-70	2,555	63		0	0	0	1
CD-73	4,650	79		0	0	1	2
CD-74	7,715	91		0	0	1	3
CD-75	6,953	65		0	0	1	2
CD-76	1,069	100		0	0	1	1
CD-77	1,865	88		0	0	0	0
CD-78	2,500	36		0	0	1	1
CD-80	3,520	92		0	0	1	2
CD-201	43	100		0	0	1	0
CD-202	426	100		0	0	1	1
OD-22	This DCA crosses state boundary; data are illustrated in Oregon Klamath province table.						
Totals:	329,122	69		10	0	59	90
Totals for all lands in province:					20	135	

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for this province.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.20. Summary comments on the designated conservation area (DCA) network in the California Coast province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
CD-47, CD-48, CD-50, and CD-52	Limited federal land ownership does not provide opportunities to delineate category 1 DCAs. These category 2 areas are important for demographic support of the owl population in the northern California Coast Range. These DCAs also provide for population connectivity with interior DCAs on national forest lands.
CD-53, CD-54, CD-56 through CD-63, CD-65 through CD-67, CD-69, CD-70, CD-73 through CD-78, CD-80, CD-201, and CD-202	Many BLM parcels in the California Coast province are delineated as DCAs. Their size and distribution limits the ability of any parcel to support more than five pairs. Many of these small DCAs may not be able to support even a single pair of owls without additional suitable habitat on surrounding state or private lands. The value of these areas is to connect suitable habitats throughout the north coast area and to provide short-term demographic support and future nesting areas in conjunction with suitable habitat on private lands.

Southern Del Norte and northern Humboldt Counties. Federal lands in this area have too little habitat capability to support 20-pair clusters without support from nonfederal lands. DCAs CD-47 and CD-53 are expected to maintain fewer than three pairs each, but their owl populations could be strengthened by owl populations on nearby state and private lands.

Southern Humboldt and central Mendocino Counties. As in the rest of the province, federal land and state parks in this area are too small to support 20-pair clusters and should be supplemented by nearby lands with suitable habitat. Also, the category 2 DCAs and the residual habitat areas in this area should be supported by nonfederal lands to make them consistent with size, spacing, and density criteria. Three category 2 DCAs could be upgraded to support 20 owl pairs by consolidation with other DCAs and management areas on private lands. Dispersal habitat on federal and nonfederal land is needed among areas managed for owl clusters.

Biological goals on nonfederal lands

Minimum rangewide recovery goals for nonfederal lands are described in section III.C.4. With the lack of federal land, additional recovery goals for nonfederal lands in the California Coast province are to provide demographic stability and maintain northern spotted owl distribution throughout the province. This can be achieved by conservation measures that result in the equivalent of 11 clusters of breeding pairs appropriately spaced throughout the province, with adequate dispersal habitat among the clusters.

The continued presence of owls in this province depends upon state and private lands. Only 11 percent of the known owl sites in the province are on federal lands, and these sites alone are insufficient to maintain owls through-

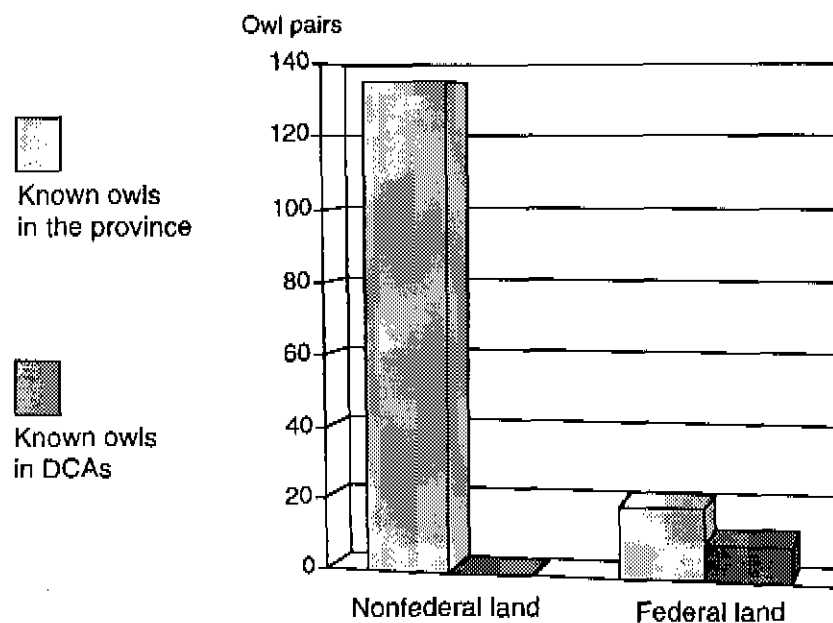


Figure 3.23. Known owl pairs in the California Coast province and in DCAs within the province.

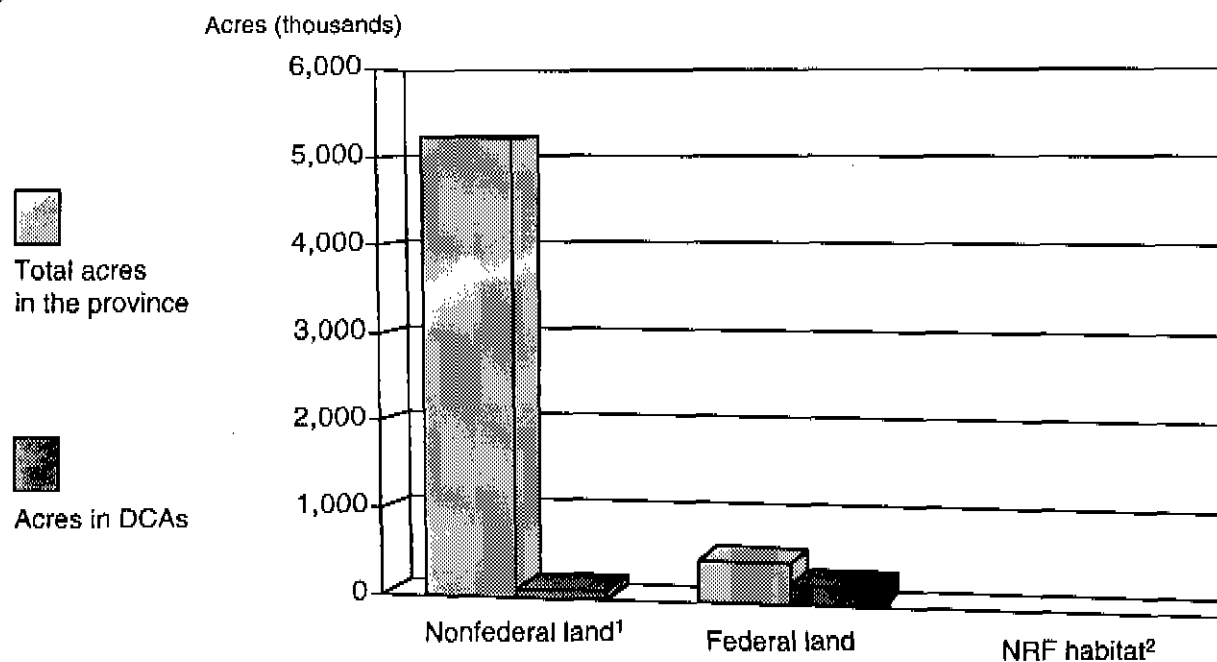


Figure 3.24. Acres in the California Coast province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is not available for this province.

out the province. These owl activity centers on federal lands contribute to four of the 11 larger clusters needed to maintain the owl population throughout the province. Outside of the Redwood National Park areas, owl activity centers on federal land will contribute no more than 11 owl pairs to any of the clusters on nonfederal lands. Also, distances among most of the DCAs on federal lands exceed current size and spacing standards, which creates more need for dispersal habitat on the intervening nonfederal land.

There is not enough habitat in the DCAs in this area to support a sustainable owl population. Options exist for nonfederal lands to supplement existing DCAs, and to provide for clusters where spacing among DCAs exceeds the current standards. Supplementing DCAs and providing for clusters does not require reserves or set-asides of private land and can be achieved through voluntary actions on private lands and compliance with regulations.

Del Norte and northern Humboldt Counties. Nonfederal lands can be managed for nesting, roosting, and foraging habitat, for clusters or supplemental pair areas, and for dispersal habitat among owl clusters and DCAs.

Central Humboldt County. A substantial population of spotted owls occurs east and southeast of Eureka, but no DCAs are possible in this area. At least two 20-pair clusters or equivalent supplemental pair protection would be needed on state and private lands in this area to meet recovery goals for demographic stability and distribution throughout the province. Dispersal habitat should be maintained among areas managed for owl clusters.

Southern Humboldt and northern Mendocino Counties. DCAs and state parks are too small in this area to hold 20-pair clusters and must rely on other nearby lands with suitable habitat to provide demographic support. All category 2 DCAs and residual habitat areas would benefit from support by supplemental pair areas or habitat on state and private lands, as feasible and consistent with current size and spacing criteria. At present, approximately 25 category 2 DCAs and 10 residual habitat areas in this area are on federal land and would benefit from this support. For example, three category 2 DCAs have the capability to be upgraded to support 20 owl pairs by combining them with other DCAs and instituting favorable management on private lands. Fourteen owl activity centers on state park lands also would benefit from this type of supporting habitat. In addition to providing nesting, roosting, and foraging habitat, dispersal habitat is needed among areas managed for owl clusters and DCAs.

Southern Mendocino to northern Sonoma Counties. Two 20-pair owl clusters are needed in this area to support owl populations farther south and east in Sonoma, Napa, and Marin Counties. The clusters would be best placed in the generally suitable habitat near the coast; habitat of naturally low suitability is found west and southwest of Clear Lake. Adoption of standard spacing among clusters would result in locating one in southwestern Mendocino County and one in northwestern Sonoma County. One state park could serve as the basis for a cluster, supported by management for additional pairs on private land.

Southern end of the province. Owls in the southern part of the California Coast province have the highest risk of extirpation because of their isolation. Habitat in northern Marin County, northeastern Sonoma County, and most of Lake County is either unsuitable, or is of low or questionable suitability. Owls may not disperse readily across these areas. Three state parks in this area are large enough to serve as the basis for three breeding clusters, if augmented by private lands. However, it may not be feasible to support 20 owl pairs in these breeding clusters. Known owl activity centers on state and private lands in these breeding clusters should be managed conservatively to retain all owl

nesting and roosting habitat until monitoring and research indicate that the threat of local extirpation has been diminished substantially.

Implementation options on nonfederal lands

Several options are available for achieving recovery goals on nonfederal lands in the California Coast province. There are a number of existing reserves, including federal lands and state parks. Most of the state land in the province is in two parks and can be expected to provide owl habitat over the long term.

Managed forests on private lands also can provide for nesting, roosting, foraging, and dispersal habitat. The potential for finding additional owls through surveys is high, and may create an incentive for private landowners to develop landscape management approaches for owl conservation. At least one large industrial landowner is developing a habitat conservation plan (HCP), and other landowners have expressed interest in developing an HCP or other habitat conservation measures.

State forest practices rules and the state-sponsored HCP process provide other avenues for landscape management. Current take prohibitions do not provide directly for adequate clustering of owl pairs or spacing of owl clusters, because the state forest practices rules place constraints on cumulative impacts, activity in riparian zones, and the size and spacing of clear-cuts. Amendments to the forest practices rules would be needed to require specific habitat retention standards, different "zonal" practices, and long-term plans. The forest practices rules currently provide for long-term plans only on nonindustrial ownership. The state-sponsored HCP program is addressing these issues and is expected to be completed in early 1993.

Land acquisition opportunities are expected to be limited because of the lack of federal lands available for exchange, lack of funding for purchase, and concerns regarding removing land from private ownership.

There are potential implementation difficulties in northern Marin, northeastern Sonoma, and Lake Counties because of habitat and ownership patterns. Owl conservation in this area may have to rely on take prohibitions on a case-by-case basis. The ability to maintain owl populations is limited by poor suitability and distribution of habitat, numerous small ownerships, and the inability to manage landscapes collectively. Existing local land trusts and open-space districts may provide funds for land acquisition but probably will require active participation of county government through local land-use regulation.

Implementation of recovery goals would be expedited if landowners were given flexibility in the placement of clusters, although this approach may require greater monitoring efforts and conservative targets.

Three options are presented for achieving recovery goals, however, other options may be appropriate if they achieve equivalent or better protection for the owl. Given the variation in land ownership and specific conservation needs throughout the province, a combination of options is likely to be implemented eventually. Each option must be evaluated by its ability to achieve recovery goals if fully implemented.

Option 1: Management of individual owl sites

This option would build clusters of owls based on current knowledge of owl sites. Clusters would be identified in a specific location, quantity, and quality of habitat.

This option would provide the opportunity for timber management on private lands that includes clusters or support DCAs and reserved pair areas while meeting standards for suitable habitat quality and quantity. Managing to maintain dispersal habitat is recommended for private lands among DCAs and owl clusters on private lands. In northern Marin, northeastern Sonoma, and Lake Counties, concerns about low population and connectivity to the adjacent province would preclude timber harvest of suitable owl habitat.

Habitat requirements for individual sites could be identified by implementing minimum stand structure provisions for each habitat type within this province. On private lands, owners could manage owl habitat if safeguards ensured the maintenance of local owl populations. Safeguards could take the form of performance bonds, mitigation banks, or dedicated areas such as easements.

Implementation and monitoring under this option would require substantial owl surveys. Consequently, this option, compared to other options, may be harder to establish because of management on a site-by-site basis. This option would provide landowners with the least amount of management flexibility at the site level and may raise equity issues among ownerships. Private landowners who have conducted owl surveys on their lands may have a disadvantage over those who have not surveyed for owls when known owl sites are used to establish clusters.

This option, compared to the other two options, may be easier to monitor for compliance, and would allow site-specific management practices tailored to site-specific conditions. The site-by-site application may make it easier to review the impact of management practices. Protecting known nest sites within a larger landscape strategy of clusters and dispersal habitat may present lower risk to owl populations over the short term.

Option 2: Management of clusters: fixed boundaries

This option would allow for management at the 20-pair cluster level, in lieu of the individual site level. Clusters would be located with fixed boundaries, and habitat quality and quantity within the cluster would be managed to support a specified number of owls. Other standards (e.g., minimum habitat block size, spacing of habitat blocks) would be provided. Location of owl sites within the cluster may be more variable over time than in option 1. The cumulative impact of timber harvesting and other forest management activities on owl habitat within the cluster would be evaluated, and mitigation measures could be proposed to offset the impacts. Owl clusters in the southern extreme of the province would be managed to retain all suitable habitat.

Habitat standards and safeguards would be similar to those in option 1. Since fixed boundaries for supporting DCAs and clusters on private lands are recommended, implementation could rely on known existing owl sites or additional owl survey work. Once cluster areas are established, monitoring habitat conditions over time would be more important than individual owl surveys. This option would provide greater flexibility to landowners than does option 1 and allow for local management options.

This option also would require a higher level of habitat monitoring and perhaps greater amounts of habitat than would option 1, because the status of owl pairs is not stressed. If long-term monitoring determines that forest management achieves expected results in owl populations, a longer time or greater conservation action may be required to correct the strategy.

Option 3: Management of clusters: general boundaries

This option would allow greater flexibility to private landowners in meeting recovery objectives because the boundaries of areas managed for owl clusters are generalized. Each cluster would have a designated general size, based on the numbers of owls it should contain and the home range size that would be necessary for owls in that province. Only a general location would be specified to meet spacing guidelines; the location of the perimeter would not be fixed. Guidelines would be based on maintaining owl pairs in clusters rather than maintaining isolated owl pairs or individuals. Landowners would determine where owls would occur within clusters. An owl cluster within a single landownership would be managed by the landowner. An owl cluster that encompasses land owned by several landowners would be managed through a coordinated resource management plan agreed upon by all landowners. Owls in the extreme southern portion of the range would be managed in enlarged clusters with no removal of owl nesting and roosting habitat.

This option would provide the landowner with the greatest number of options in land management and would require minimal owl surveys. Owl surveys could be limited to those required to estimate population trends for the province. The option also could serve as the framework for a more generalized, landscape-based habitat conservation strategy that could consider other species, biological diversity, and ecosystems.

This option would require substantial management planning by landowners to ensure that recovery goals will be achieved and maintained. Habitat monitoring would be the paramount concern and would be the responsibility of landowners and implementing agencies. This strategy also would carry a higher risk of declines in owl populations during the short term or delays in meeting recovery goals, since many of the relationships between owls and forest management over the long term are unclear at this time and have not been tested.

Achieving recovery goals for the province will require strong coordination among large and small private landowners, the state, and the state forest practices rules. In many areas the need for BLM participation will be high because of the numerous small BLM parcels adjacent to state and private lands. In Marin, Sonoma, and Napa Counties, coordination with local and county governments may be critical to maintain owls on private lands and to use zoning to help maintain owl habitat. Coordination in managing owls in this province is underway in the form of a state-sponsored habitat conservation plan (HCP) for the northern spotted owl in California.

California Klamath Province

Province description

The California Klamath province is located between the California Coast and the California Cascades provinces. It is a continuation of the Oregon Klamath province, south to the Clear Lake Basin in the inner Coast Range. The area is mountainous and covered primarily with Douglas-fir forests. Mixed Douglas-fir forests are common at lower elevations with Douglas-fir/true fir forests at higher elevations. The province land ownership is dominated by four national forests, but includes a few parcels of BLM lands near the eastern border. There are some private forestlands, also near the eastern edge of the province.

The Hoopa Indian Reservation occurs within the California Klamath province; recovery contributions of the Hoopa Tribe are described in section II.C.8.

There are 950 historic owl activity centers in the California Klamath province, 88 percent of which are on federal lands. During the 1986-90 period, pairs of owls were identified at 455 of these sites. Eighty-eight percent of these pair activity centers occur on federal lands.

The major threats to the northern spotted owl population in this province arise from reduction in suitable habitat and resulting loss of owls caused by timber harvesting during the last 40 years. Catastrophic fires occur within the province and have the potential to destroy forested areas large enough to support a 20-pair cluster.

Spotted owls in this province are important to maintain genetic contact between the northern spotted owl and California spotted owl subspecies. Genetic contact is thought to be important because of the low numbers and scattered distribution of owls in the California Cascades province, and recommended DCAs reflect that concern.

Biological goals and implementation on federal lands

Fourteen category 1 and 19 category 2 DCAs are recommended in the province (Tables 3.21 and 3.22). All category 1 DCAs occur in the western and northern part of the province, providing the demographic stability for owl populations in the province. The category 1 DCAs include little state or private land; these nonfederal lands support few owls and are not essential for demographic stability. Large DCAs in the northern and western portions of the province have better natural site conditions and higher known owl populations than do the eastern and southern portions of the province. The presence of these DCAs reduces the need for contributions from state and private land in the western portion of the province.

Category 2 DCAs are common along the eastern edge and the southern end of the province. Twelve reserved pair areas will be needed in the southern end of the province where category 2 DCAs are deficient in suitable habitat, and along the eastern edge of the province where spacing requirements among DCAs cannot be met.

The DCAs contain 52 percent of the owl pairs and 41 percent of the nesting, roosting, and foraging habitat on federal land in the province (Figures 3.25 and 3.26).

Outside of the DCAs, federal lands should be managed under matrix prescription A.

Biological goals and implementation options on nonfederal lands

Scientific goals for nonfederal lands in the province are to provide for local demographic support and maintain distribution across the province and between this province and the California Cascades province. Given the dominance of federal land ownership in the province, there is no need for local population clusters on state and private lands in the western zone. Recovery will be enhanced by supporting existing DCAs in the eastern and southern zones with additional pairs from private lands, and by managing for a new cluster on state, private, and BLM lands in eastern Trinity County.

Achieving the recovery goals for nonfederal lands in this province would contribute substantial support to the demographic stability of owl populations within the province, and increase the likelihood of more rapid recovery. Dispersal sinks, which negatively affect overall population stability, could result if

Table 3.21. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California Klamath province. (More detailed information, including projected owl pairs on nonfederal land is in Appendix J, Table J.10.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³		Current Projected Federal ⁴	Future Projected Federal ⁵
				Federal	Nonfed		
CD-1	104,956	99	42,240	7	0	27	28
CD-2	55,596	99	26,040	9	0	21	23
CD-3	38,032	95	14,200	27	0	28	25
CD-4	62,989	95	35,840	16	0	22	25
CD-5	83,065	100	14,960	8	0	25	29
CD-6	47,559	100	13,000	10	0	20	22
CD-7	14,171	96	1,840	7	0	6	8
CD-8	140,630	100	71,280	23	0	42	44
CD-9	6,299	100	2,120	1	0	2	2
CD-10	56,011	95	17,520	13	0	21	23
CD-11E	97,567	98	27,600	9	0	22	24
CD-11W	95,908	99	44,320	12	0	26	28
CD-12	54,928	95	17,400	8	0	21	23
CD-13	43,795	91	24,080	7	0	16	20
CD-14	30,042	91	4,040	4	0	5	7
CD-15	112,694	98	34,480	12	0	29	31
CD-16	66,371	98	13,680	6	0	22	24
CD-17	33,597	97	6,000	3	0	6	7
CD-18	50,221	97	8,600	2	0	9	14
CD-19	27,563	88	5,520	4	0	5	6
CD-20	9,758	93	1,880	4	0	3	3
CD-21	25,743	98	5,440	2	0	5	7
CD-23	7,145	99	2,760	2	0	4	4
CD-24	3,383	100	1,360	1	0	1	1
CD-25	4,218	99	1,680	1	0	1	1
CD-26	1,716	54	360	1	0	1	1
CD-27	2,262	83	480	1	0	1	1
CD-29	23,613	95	4,960	2	0	6	7
CD-30	13,187	85	3,000	1	0	3	4
CD-31	40,191	78	7,840	3	0	8	15
CD-32	9,811	71	2,280	3	1	2	3
CD-33	4,133	96	760	0	0	0	2
CD-34	3,138	78	240	1	0	1	2
OD-20	This DCA crosses state boundary; data are illustrated in Oregon Klamath province table.						
Totals:	1,370,292	96	457,800	210	1	411	464
Totals for all lands in province:				1,105,550	403	52	

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1986 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions. See Appendix J for further details.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See Appendix J for further details.

Table 3.22. Summary comments on the designated conservation area (DCA) network in the California Klamath province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
CD-3 and CD-8,	These category 1 DCAs each currently support 20 or more pairs of owls.
CD-1, CD-2, CD-4 CD-5, CD-6, CD-10, CD-11E, CD-11W, CD-12 CD-13, CD-15, and CD-16	These category 1 DCAs currently support fewer than 20 known pairs of owls. With the exception of CD-13, they all have the current potential to support at least 20 pairs. All of them have the future potential to support at least 20 pairs.
CD-7, CD-9	These DCAs do not support 20 pairs. CD-9 provides connectivity around a high-elevation wilderness area. DC-7 provides connectivity to DCAs farther east.
CD-14, and CD-17 through CD-21	This drier and naturally fragmented habitat will support from 3 to 15 pairs in the future.
CD-23 through CD-27, CD-32 through CD-34	Because of the naturally fragmented landscape, larger multipair DCAs are not possible. These DCAs provide connectivity to DCAs to the west and provide the link between the ranges of the northern spotted owl and the California spotted owl in the Sierra Nevada.
CD-29 and CD-30	No opportunities exist to support Category 1 DCAs. DCAs are delineated where owls are currently known, future habitat opportunities occur, and where the only demographic support for this local population is possible. Suitable habitat is not uniformly distributed over this region because of moisture and soil conditions.

nonfederal lands are not managed to support the federal conservation efforts. Increases in demographic support assist in maintaining the linkage between the California Klamath and the California Cascades provinces, and support populations in the adjacent California Cascades province as well. This linkage could be crucial to maintaining the owl population in the California Cascades province. Maintaining strong populations of the northern spotted owl in the California Klamath and Cascades provinces also would help maintain the linkage to the California spotted owl.

Western zone: No additional owl clusters or DCA support for owls are needed on state and private lands in the western part of the province, other than management for dispersal. DCAs on federal land should be consolidated through the inclusion of inholdings.

Eastern and southern zones: The eastern and southern parts of the province are drier and support a lower known population of owls, reflected by the lack of category 1 DCAs. At least six category 2 DCAs and three reserved pair areas could be supported with currently known sites on state and private lands. Although this probably would not result in upgrading to category 1, it would increase the stability of the relatively small owl populations in these clusters.

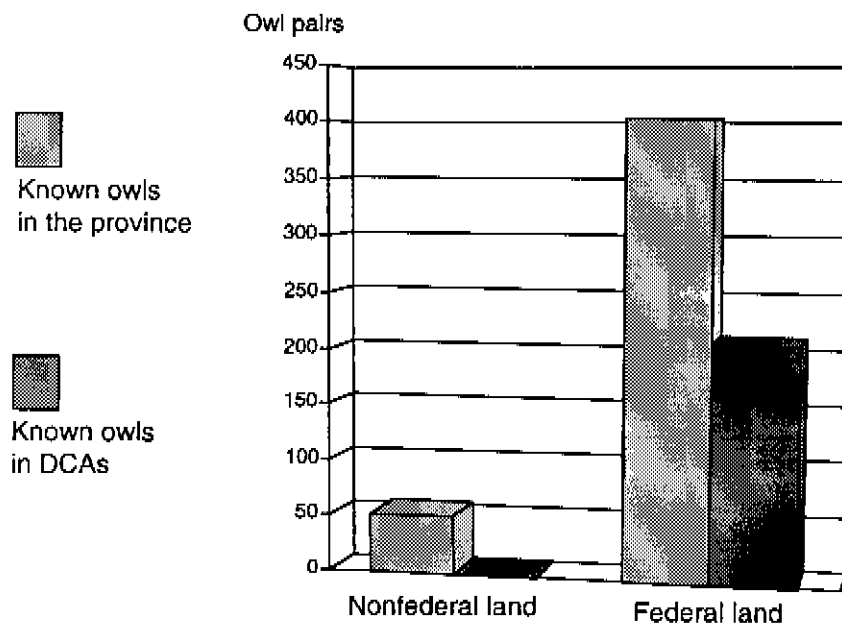


Figure 3.25. Known owl pairs in the California Klamath province and in DCAs within the province.

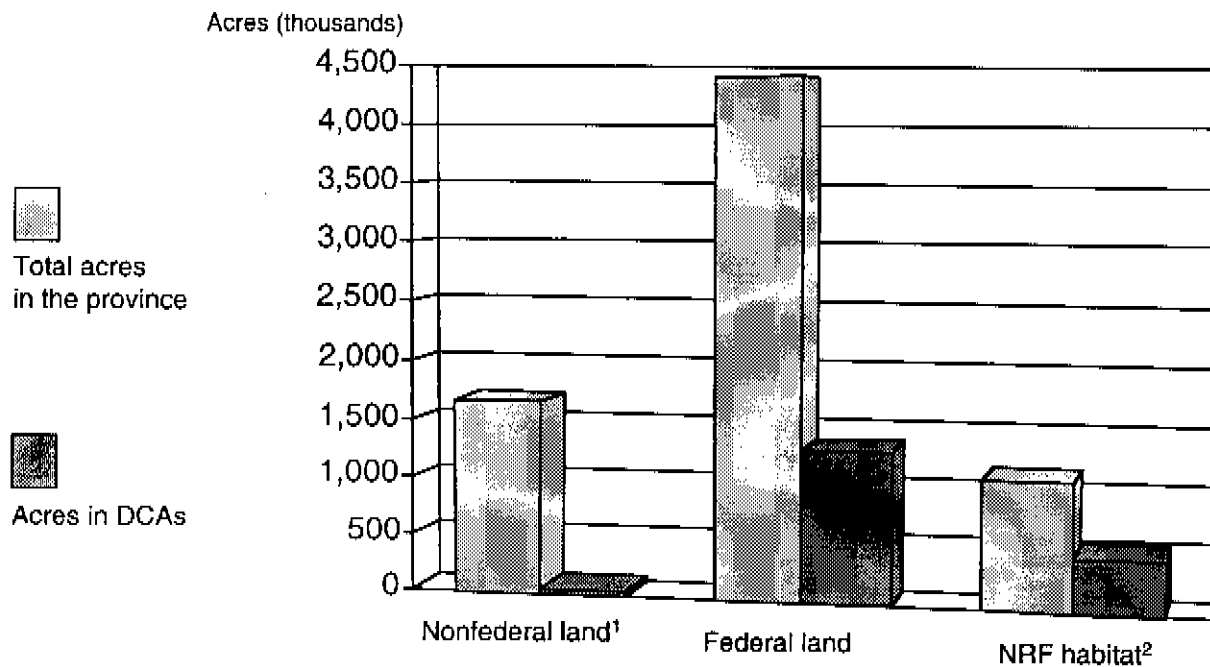


Figure 3.26. Acres in the California Klamath province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

Managing for a new cluster on state, private, and BLM lands in eastern Trinity County would enhance recovery. This cluster would provide stronger demographic support in this part of the province and better connectivity across the southern end of the Trinity Alps to the California Cascades province.

Implementation options on nonfederal lands

Numerous alternatives exist for achieving recovery goals on nonfederal lands in the California Klamath province. There are substantial reserves of public lands, and the recommendations for federal DCAs incorporate most of them. One large private timberland owner has committed to a management plan incorporating extensive owl surveys to ensure that owls will not be taken as a result of the landowner's timber operations. A number of other timberland owners in the province voluntarily practice partial entry or uneven-age management which lessens impact to owl habitat. Other timberland owners have expressed an interest in developing comprehensive owl management plans for their ownerships, in compliance with the current state forest practices rules. The large number of owl sites in the area is an incentive for developing these plans, as is the state-sponsored HCP, which could benefit smaller acreage landowners in the province.

Forest practices rules would have to be amended to require specific habitat retention standards, different practices in different "zones," and long-term plans. Forest practices rules currently provide for long-term plans on nonindustrial ownerships only. The state-sponsored habitat conservation plan (HCP) is underway and addressing these issues. The HCP is expected to be completed in early 1993.

The extensive checkerboard ownership pattern in the province offers greater flexibility to explore land exchanges.

Land acquisition is likely to be less attractive, since many of the timberland owners also own processing facilities that depend on a stable timber base.

The feasibility and likelihood of early implementation of actions to achieve the recovery goals will increase if landowners are given greater flexibility to designate areas for maintaining nesting, roosting, and foraging habitat for supporting DCAs, but this may require greater effort in monitoring and establishment of more stringent initial objectives.

Four options are presented for achieving recovery goals. The options are not exhaustive, and other options may be appropriate if they achieve equivalent or better protection for the owl. Other options might provide for more general landscape level habitat management, protection for other species and long-term management. Given the differences in land ownership and specific conservation needs throughout the province, it is possible that some combination of the options eventually will be implemented. All options must be evaluated based on the likelihood that they will achieve recovery goals when fully implemented.

Option 1: Management of owl sites adjacent to federal DCAs

This option would consolidate DCAs on federal land through the inclusion of inholdings in the western zone. Inholdings would be managed to create and maintain suitable owl habitat. The option would offer nonfederal support to category 2 DCAs and reserved pair areas in the eastern and southern zones, using sites less than, or equal to, 3 miles from the current DCA boundary, and all sites within the DCA boundary. Sites used for supporting federal areas would have specified locations (e.g., confine site location to a specific drainage

and to within 0.5 miles of the activity center), and rules that would ensure that the appropriate quantity and quality of habitat be maintained. Dispersal habitat also would be designated throughout the province. A 20-pair cluster in eastern Trinity County would be managed with fixed boundaries and locations of sites.

Extensive surveying for owls would be necessary to implement this option and monitor it over time. Fixed boundaries and site locations increase the certainty during the short term that owls will be found, but may raise issues of equity between landowners. Unless the area has been extensively surveyed, the use of existing known sites as the basis for restricting management may effectively penalize those owners who have conducted surveys and are engaged in active research. This option limits the flexibility of landowners with the responsibility of providing for owl sites.

Option 2: Management of owl sites at the watershed level

This option would provide a management strategy to maintain dispersal habitat on private inholdings within federal DCAs in the western zone, but would create incentives for consolidating the inholdings with DCA management. It would provide nonfederal support for category 2 DCAs and reserved pair areas in the eastern and southern zone, using lands within the general watershed areas containing the DCA. Sites would be distributed based on known owl occurrence. Owl sites within the major watersheds currently encompassed by the DCA would be recommended to provide support for the DCA. These sites would be managed to ensure that the appropriate quantity and quality of suitable habitat would be maintained and that the location would be maintained (e.g., similar to current state forest practices rules regarding take, and confine the site activity center to a 3,000-acre area within a specific drainage). Dispersal habitat would be maintained throughout the province. A cluster of 10 pairs is an objective for eastern Trinity County.

This option provides somewhat more flexibility to private landowners. It is still based on managing for individual activity centers, so extensive owl surveys would be required. The location of sites is more flexible than under option 1, and fewer sites are likely to be required throughout the province. Higher risks may be associated with maintaining only dispersal habitat on inholdings within DCAs in the western zone. Implementing this option, which is based on currently known activity centers, may effectively penalize landowners who have surveyed extensively for owls, unless the area has been extensively surveyed.

Option 3: Management of all known owl sites

This option would maintain dispersal habitat on private inholdings within DCAs in the western zone, but would create incentives for consolidating the inholdings with DCA management. Nonfederal land would support category 2 DCAs and reserved pair areas in the eastern and southern zone, using all known sites. Habitat requirements for individual activity centers could be identified and managed by implementing minimum stand structure provisions for each habitat type within province. Additionally, guidelines would be provided at the cluster level to maintain such characteristics as the percentage of suitable habitat in the cluster, the minimum stand size and distribution of that suitable habitat, and the presence of high-value habitat at the activity center. Dispersal habitat would be designated throughout the province.

This option also would include establishing a new cluster on state, private, and BLM lands in northeastern Trinity County. This cluster has the potential for 20 activity centers. Habitat would be provided by prescriptive management rules controlling the quantity and quality of habitat to be maintained. It would

confine site location to a specific drainage and would be within 0.5 miles of the activity center.

This option would provide the best demographic support for the populations in these areas where habitat conditions preclude maintaining large enough clusters to provide a good chance of maintaining a viable population over time. Over time this might result in forming larger clusters than currently possible and in increasing local population stability.

This option would require extensive owl surveys to identify owl sites and to monitor implementation. The option creates a disincentive to locate owl sites and an incentive to harvest suitable but unoccupied habitat. Management strategies for areas where spatial distribution of known locations do not "match" with needs to support DCAs.

Option 4: Landscape-based habitat management

This option would require maintaining dispersal habitat on inholdings within DCA boundaries in the western zone, but would provide incentives for maintaining nesting, foraging, and roosting habitat. Category 2 DCAs and reserved pair areas in the eastern and southern zones would be supported by providing suitable habitat in areas within major watersheds included within DCA boundaries. Specific location of suitable habitat for activity centers would not be specified, but quantity and quality would be ensured at the watershed level. Suitable habitat to support 10 pairs of owls would be maintained in eastern Trinity County, using existing federal lands as the basis. Specific owl site locations and cluster boundaries would not be designated.

This option provides greater flexibility to the private landowner. It would not require owl surveys to the extent of other options. The option provides incentives for landowners to participate in landscape level management, and to locate owls or manage habitat in desirable locations.

Coordination. Land ownership is dominated by the national forests. Private lands in the province are primarily large industrial forest holdings. BLM lands constitute a small but relatively important portion of the area where management of a cluster is proposed among multiple owners.

This option requires coordination between large industrial forest landowners and the state and its forest practices regulation mechanism. A state-sponsored habitat conservation plan (HCP) for the northern spotted owl in California is being drafted that will provide the coordination necessary to accomplish management suggested by this option.

California Cascades Province

Province description

The California Cascades province is located in the center of the north end of the state, between the Oregon Cascades province, the Klamath provinces, and the range of the California spotted owl at the north end of the Sierra Nevada. Suitable owl habitat generally is fragmented on a broad scale by the Shasta Valley, Mt. Shasta, and other high elevation areas, areas of unsuitable soils, and areas of marginal, low elevation habitats. Suitable forest habitat is predominately on two national forests although there are significant blocks and checkerboard ownership areas where forests occur on mostly industrial private lands. This area forms the linkage between the range of the northern spotted owl and the range of the California spotted owl.

Spotted owls have been found at 86 sites in the province; pairs have been verified at 34 of these in the last 5 years.

The major threats to this northern spotted owl population are its low numbers and density, and the fragmentation of the habitat that keeps pairs from aggregating and forming stable demographic units. Also, habitat conditions tend to isolate the populations inside the province from one another and from populations in neighboring provinces.

Low population numbers, low amounts of suitable habitat, and poorly distributed suitable habitat limit the contribution to recovery that historically and naturally can be expected from the California Cascades province. The population is at high risk for local and even province-wide extinction.

Minimum rangewide recovery goals for nonfederal lands are described in section III.C.4. Additional goals for nonfederal lands in the province are to provide substantial demographic support to DCAs, maintain owl distribution, maintain the connection between northern spotted owls and California spotted owls, and maintain all known and future sites on nonfederal lands.

The objectives for this province are considered important to maintaining the link between the two subspecies of the spotted owl in California. Providing local demographic stability to the province, with owls well distributed, is necessary to maintain the link. The value of the contact may be the genetic interchange between the two subspecies. This exchange is not likely if there are no northern spotted owls between the Sacramento River (north of Redding) and the California spotted owls at the northwest edge of Lassen National Forest.

However, the northern spotted owl population and habitat conditions in this area are such that the likelihood of achieving a province population size with a relatively low risk of extinction is not great. This, coupled with the lack of information on the northern spotted owl's historical occupancy of the province and the small population size, reduce the importance of the owls in this province to the rangewide preservation of the northern spotted owl subspecies.

Biological goals and implementation on federal lands

Twenty-three DCAs are recommended in the province (Table 3.23). Because the owl population in the province is small and dispersed, none of these will likely contain 20 or more pairs of owls and only one of the category 2 DCAs will likely contain more than ten pairs. Two reserved pair areas are recommended in the province between CD-108 and CD-109. The DCAs contain 92 percent of the owl pairs and 61 percent of the nesting, roosting, and foraging habitat known on federal lands in the province (Figures 3.27 and 3.28).

Remaining federal lands in this province should be managed under matrix prescription B.

Biological goals on nonfederal lands

Unless owls on state and private lands are managed to complement the owl population on federal lands, the benefits of conservation efforts on federal lands will be limited and the link between the two subspecies will likely be lost over time.

Implementation options on nonfederal lands

Because of the particular threats to the northern spotted owl in the California Cascades province, relatively few options are available for achieving recovery goals. Although a number of tools are available, conservation over the short term must focus on individual owl sites to offset the low population levels and poor distribution of suitable habitat.

Achieving recovery goals in this province will be potentially difficult. Existing reserves and DCAs may not have sufficient amounts of suitable habitat within them. Currently practiced partial entry and uneven-aged management may be amenable to modification to provide suitable habitat, and there is the possibil-

Table 3.23. Summary of acreage and owl pairs for designated conservation areas (DCAs) and for all lands in the California Cascades province. (More detailed information, including projected owl pairs on nonfederal lands, is in Appendix J, Table J.11.)

DCA Ident. Number	Acreage			Owl Pairs			
	Total	Percent Federal Land ¹	NRF Habitat Federal ²	Known Owls ³ Federal	Nonfed	Current Projected Federal ⁴	Future Projected Federal ⁵
CD-28	41,356	83	5,240	7	0	5	7
CD-35	13,992	95	2,160	0	0	1	2
CD-36	2,133	98	1,040	0	0	0	0
CD-37	5,710	99	240	1	0	1	2
CD-38	9,982	96	2,560	0	0	1	3
CD-39	3,722	99	880	0	0	0	0
CD-40	2,419	91	640	1	0	1	1
CD-41	3,600	87	1,200	1	0	1	1
CD-42	70,985	91	22,920	5	0	10	12
CD-43	14,442	94	1,120	2	0	3	4
CD-44	11,095	94	2,920	2	0	2	3
CD-45	38,644	55	3,840	1	0	4	5
CD-101	1,913	93	—	0	0	1	1
CD-102	3,032	93	400	0	0	1	1
CD-103	2,699	98	40	1	0	1	1
CD-104	2,881	47	440	0	0	1	1
CD-105	1,267	88	240	0	0	1	1
CD-106	1,994	100	800	0	0	1	1
CD-107	2,880	96	2,240	1	0	1	1
CD-108	2,560	97	240	1	0	1	1
CD-109	1,910	88	200	0	0	0	0
CD-110	2,881	100	640	0	0	1	1
CD-111	2,881	90	320	0	0	1	1
Totals:	244,978	85	50,320	23	0	39	50
Totals for all lands in province:			82,240	25	9		

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF = nesting, roosting, and foraging habitat for spotted owls. Habitat information was not available for nonfederal lands.

³Numbers are pairs of spotted owls verified in a 5-year period either 1966 through 1990 or 1987 through 1991.

⁴This is an estimate of the number of pairs of owls that the DCA would be expected to support on federal lands if the population stabilized with current habitat conditions.

⁵This is an estimate of the number of pairs of owls that the DCA might support in the future on federal lands if habitat were recovered. See

Appendix J for further details.

Dash (—) = data not available.

Table 3.24. Summary comments on the designated conservation area (DCA) network in the California Cascades province. (Section III.C.2. and Appendix I provide further information on the criteria and process used to delineate these areas.)

Designated Conservation Area	Comments
CD-35 through CD-41, CD-101 through CD-111	Because of the naturally fragmented landscape, larger multipair DCAs are not possible. These DCAs provide connectivity to DCAs to the west and provide the link between the range of the northern spotted owl and the California spotted owl in the Sierra Nevada.
CD-28, CD-42 through CD-45	No opportunities exist to support category 1 DCAs. DCAs are delineated where owls are currently known, where future habitat opportunities occur, and where the only demographic support for this local population is possible. Suitable habitat is not uniformly distributed over this region because of moisture and soil conditions.

ity of individual HCP or no-take plans. The scarcity of owls may not make landscape management attractive to landowners, especially if few owl sites are detected through no-take surveys. Forest practice rules do not provide for permanent protection of nest sites if they become unoccupied, and the rules would have to be amended. Habitat on state and private land could be obtained by purchase or land exchange. There is some potential for land acquisition, due to checkerboard ownership, but land acquisition likely would alter radically timber supply access among different owners. Land purchase is likely to be expensive, and landowners are likely to be concerned about removing land from private ownership, given the need for a timber base to supply existing mills.

Short-term deferral of harvest, until a long-term management strategy with low risk to the population can be drafted, might be accomplished through tax exemptions or habitat conservation easements, but the institutional mechanisms for accomplishing this are not yet developed.

One option is presented for achieving recovery goals. Other options may be appropriate if they achieve equivalent or better protection for the owl. All options must be evaluated based on the likelihood that they will achieve recovery goals when fully implemented.

Option 1: Manage existing owl sites to establish clusters

This option would include all currently known owl sites on nonfederal lands, and any new sites found in the next few years of intensive surveys, as supplemental pair areas. This would increase the demographic stability of the province over the short term. In the short term, existing suitable habitat would be retained, even if a site becomes unoccupied. Attempts should be made to combine sites on federal, state, and private lands into clusters of mutually supporting owl pairs. Future evaluation would have to be made to determine if larger clusters could be designated and maintained in a pattern that would provide a lower risk of future local extinction. Combining with other sites may not be feasible for some areas that will remain as reserved pair areas due to

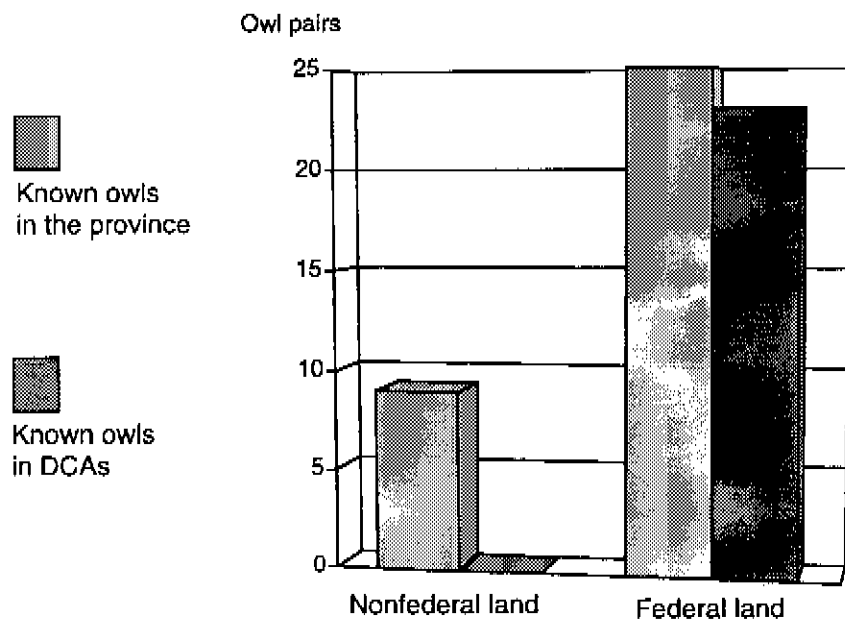


Figure 3.27. Known owl pairs in the California Cascades province and in DCAs within the province.

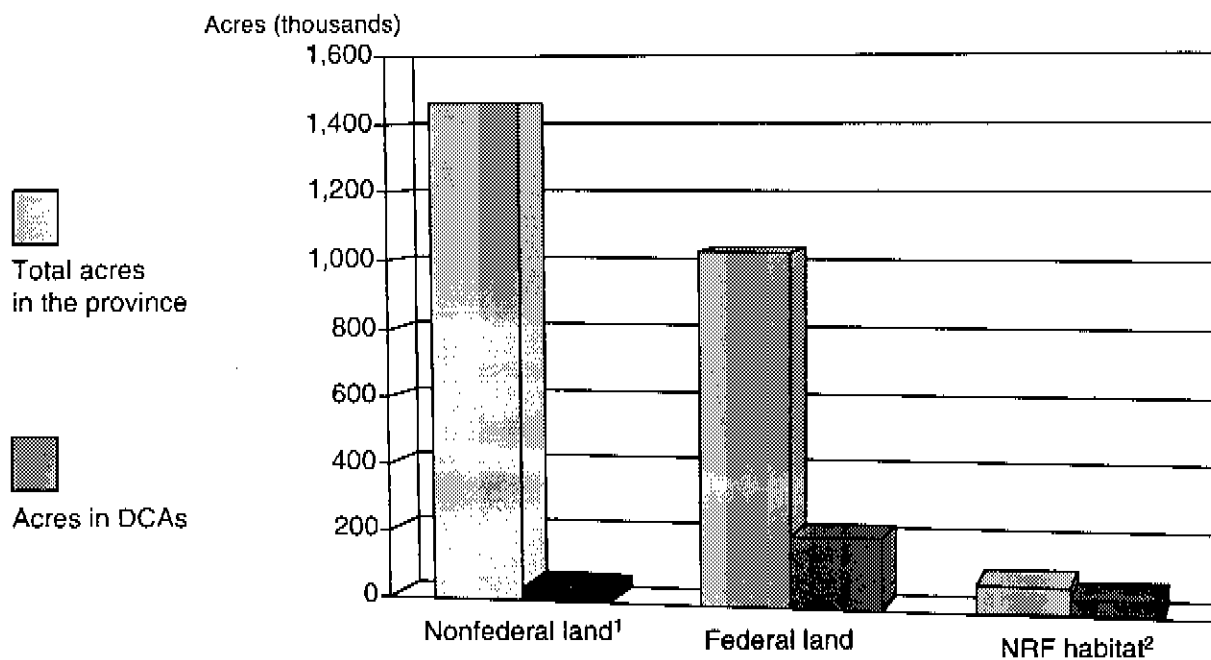


Figure 3.28. Acres in the California Cascades province and in DCAs within the province.

¹Management of nonfederal lands within the perimeter of designated conservation areas is discussed in the narrative.

²NRF habitat = nesting, roosting, and foraging habitat. This information is available only for federal land.

their distance from other sites. Areas within clusters that do not have owls should be evaluated for their potential habitat suitability. If these areas can support owl habitat, measures (i.e., prescriptions for certain habitat quality and quantity, time schedule for growth, stand management requirements, and potential management options) should be drafted to guide creation of owl habitat. Dispersal habitat should be maintained throughout the province.

Management of these clusters will be a mixture of practices because of the mix of ownerships. All sites on state and private lands need to be managed in a conservative manner to provide support for DCAs and individual owl pairs occurring outside the DCAs. Tools for implementation include regulations that provide for the quality and quantity of owl habitat to be maintained.

This option provides limited flexibility to private landowners, but it does allow for some conservative management of existing suitable habitat. Extensive owl surveys will be necessary. Attempts to combine individual sites to form mutually supporting clusters will enhance recovery. This option provides little incentive for landowners to participate in landscape management or go beyond conformity with existing rules governing take.

Coordination. Forestland ownership in this province is dominated by national forests and large, private, industrial landowners. Only small amounts of other ownerships would be involved in maintaining local owl populations.

This option requires strong coordination among federal land management agencies and private landowners, and the state through its forest practices regulation mechanism. This process is ongoing and is being strengthened by the drafting of a habitat conservation plan (HCP) by the state. This plan should assure that both suitable owl habitat and owls occur in the same general area on both sides of the boundary between the two spotted owl subspecies.

III.

C.

5. Coordination

Need for Coordination

Implementation of the northern spotted owl recovery plan will require a level of effort that is without precedent in other attempts to recover species. The recovery plan will necessitate actions over several decades at a minimum, including long-term commitments of funding and personnel from a variety of governmental entities and the private sector. Activities will encompass a large and varied geographic area, and involve intensive monitoring, evaluation, research, and management tasks. Although these activities will be integrated with ongoing efforts in wildlife management, forestry, and silviculture to a significant extent, they have distinct objectives that address the recovery plan's delisting criteria. Also, the recovery plan will require periodic updating to reflect new scientific knowledge and the results of monitoring and evaluations.

Efficient and effective implementation of the recovery plan will require mechanisms to coordinate the wide variety of activities by the participating entities. In the short term, the Recovery Team should be maintained to provide that coordination function. Federal agencies (National Park Service, Bureau of Indian Affairs, Fish and Wildlife Service, Bureau of Land Management, Forest Service) and state government agencies need to be involved in the coordination and implementation of the recovery plan. In particular, the FWS must play a major role in assuring that the plan is implemented. This will require the FWS's commitment with respect to the consultation process and other areas. In addition, the scope and breadth of coordination clearly will require establishing a group to help facilitate recovery during the lengthy time frame contemplated in the plan.

Coordinating Group

The Recovery Team recommends a coordinating group be established to guide recovery activities over the long term. The coordinating group should be based regionally and explicitly constituted to facilitate interdisciplinary and managerial communication among action agencies, states, and the private sector in addressing the biological, forestry, and policy issues associated with recovery. This can be accomplished by including persons with technical expertise as members or, if members are management officials, by assuring the group's access to technical personnel. Each participant should determine an appropriate means of liaison with the group. For example, agencies could establish their own recovery implementation teams or regional advisory bodies.

Scope and functions. The coordinating group must be structured and its functions defined to avoid potential conflicts with the statutory mandates of the agencies involved. Therefore, the Recovery Team explicitly recommends no direct regulatory function for the group. This is to avoid creating the potential for confusion and duplication of effort of the FWS's section 7 consultation responsibilities under the Endangered Species Act, as well as the land management planning and operational mandates of action agencies. The Recovery Team recommends that the group be chartered to address the areas outlined in this section. These areas encompass broad policy and programmatic concerns that are critical to progress in the recovery effort and ultimately to achieve delisting.

-
- Recommend population and habitat monitoring standards and guidelines; provide technical advice to agencies in their implementation; and review results to assess progress.
 - Provide a forum to coordinate research agendas of the various entities involved in recovery to assure that the plan's recommendations are addressed adequately and to maximize the value of the information produced.
 - Facilitate data base consistency in the development and maintenance of technical information (particularly with respect to geographic information systems) and in monitoring and research activities, to maximize the validity and reliability of results, and to assure efficient use of funds and personnel.
 - Review research results and make recommendations concerning management practices in areas such as silviculture to promote the adoption of desired actions in on-the-ground operations.
 - Recommend recovery plan revisions based on the results of scientific research, monitoring, and the documented results of program operations.
 - Promote dissemination of technical assistance to federal and state agencies, and to nonfederal parties, as appropriate, concerning issues related to recovery such as DCA management plan development and habitat manipulation.
 - Assess policies, programs, plans, environmental impact statements, and regional guides with respect to their potential consistency with recovery objectives and provide recommendations for agency consideration.
 - Promote effective communication and coordination among the various federal and nonfederal entities involved in recovery.

Organization and membership. The Recovery Team recommends the coordinating group's scope and functions be determined before organizational issues are addressed. The Recovery Team believes a variety of organizational options is available. Regardless of the arrangement chosen, however, the group's charter should be explicit to clearly establish its role. In addition, the Recovery Team believes membership should comprise federal and nonfederal entities, including the private sector. Accordingly, the group may require chartering under the Federal Advisory Committee Act.

III.

C.

6. Monitoring and Research

The primary objectives of the monitoring and research program are to determine whether implementation of the plan is on track, determine if implementation is producing expected effects, improve the plan over time, and, ultimately, determine when it is time to begin delisting procedures. Monitoring and research are intended to support the objective of this recovery plan, to provide stabilization and recovery of the northern spotted owl population with the lowest possible economic and social costs. The plan incorporates the considerable data available on northern spotted owls, one of the best researched owls in the world (see section II.A). These data give the Recovery Team reasonable assurance that the plan will succeed in its objective of recovering northern spotted owls. However, the Recovery Team is equally certain there is considerable room for refining and improving the plan and knowledge of owls. For example, the monitoring and research program may allow refinement of recommendations on types and amounts of dispersal habitat. Ongoing research programs which focus on ecological relationships and population dynamics of owls will provide considerable new information in the next several years. In addition, ongoing management will create a landscape different from the one in which owls have been observed to date, which will expand knowledge of owl ecology in a variety of habitat settings. For these reasons, the Recovery Team expects the monitoring and research program will provide information that can be used to improve the recovery plan over time. Improvements may allow increased security of the owl population and reduction of the economic cost of recovery. In addition, the monitoring and research program will provide information needed to determine when delisting of owl populations will be appropriate.

Significant monitoring and research efforts directed at northern spotted owls have been in place for many years. These are described in Thomas et al. (1990) and USDA (1988). The ideas and recommendations presented in this section of the recovery plan repeat some aspects of those ongoing programs and build on others. It was assumed that much of what is recommended can be implemented using existing organizational structures. However, some additional structure to provide overall coordination will be necessary for the recovery plan (see section III.C.5).

Functions of the Monitoring and Research Program

To be effective, the monitoring and research program must be designed carefully to answer specific questions about owls and their responses to landscapes created by management and natural events. The program can be organized into two basic categories: 1) information needed to consider delisting of the species; and 2) information needed for adaptive management under the recovery plan. While there is some overlap between these categories, they serve as a useful framework for discussing monitoring and research efforts.

Adaptive Management

The objective of the recovery plan is delisting of the northern spotted owl throughout its range. However, the decision to delist may be years or decades

away in some or all of the range. During that time, the monitoring and research program will have a vital function producing the information needed for changing and improving the implementation of the recovery plan. The process of using such information to refine management over time has been formalized as adaptive management (Holling 1978, Walters 1986). In this recovery plan, the objective of adaptive management is to improve the biological and economic efficiency of the plan while maintaining or increasing the level of protection for owls over time.

Successful use of adaptive management requires a carefully planned structure of monitoring, research, management reviews, and management refinement. The questions to be answered by monitoring and research must be designed specifically to provide information needed by management, and there should be checkpoints or trigger points that would initiate technical or administrative reviews, possibly resulting in management changes. As part of this structure, it is helpful to divide questions into three categories:

- Implementation questions — Was management direction implemented as specified?
- Effectiveness questions — Did the actions have the effects projected in the recovery plan?
- Validation/research questions — Are critical assumptions used in building the recovery plan correct?

All three categories of information must be collected for adaptive management to be effective. Implementation monitoring assures that implementing mechanisms are operating correctly and provides the basis for oversight. It is necessary to know that the plan was implemented correctly before effectiveness monitoring can be meaningful. Effectiveness monitoring provides the basis for determining if the primary effects predicted for the plan are occurring (e.g., is habitat becoming less fragmented within DCAs?). It provides the basis for deciding if some change is needed should the plan produce outcomes different from predictions. Validation monitoring and research provide information needed to determine if the key underlying assumptions of the plan are correct (e.g., that reproductive success of owls is related to the level of fragmentation of habitat). Validation monitoring is extremely important because it tells if a change in the recovery plan is necessary and what type of change might be appropriate. Without validation monitoring, it is possible to know that a change is needed but not know what type of change would be appropriate. Validation monitoring clearly represents a blend of scientific research and monitoring and is successful only when aimed at specific management questions.

The most important implementation, effectiveness, and validation monitoring questions follow.

Implementation monitoring questions.

1. Are DCAs being established on the ground following maps and guidelines from the recovery plan?
2. Are activities inside DCAs being implemented according to guidelines contained in the recovery plan? Have the land-managing agencies produced specific plans and guidance for activities in each of the DCAs?
3. Are matrix management guidelines being followed?

Effectiveness monitoring questions.

Habitat responses.

1. Do DCAs contain the target numbers of total acres and habitat acres?
2. Are activities inside DCAs producing the predicted forest structure over time?

3. Are activities in stands in the forest matrix producing the predicted forest structure over time?
4. Are desired landscape conditions being maintained over time in the matrix?
5. Are habitat trends and causes of those trends as predicted?

Owl population responses.

1. Do DCAs provide for predicted numbers of breeding owl pairs?
 - a. Does each DCA provide for the predicted number?
 - b. What proportion of DCAs falls above and below the predicted number?
2. Are owls moving successfully among DCAs?
3. Is the trend in numbers inside and outside the DCAs as predicted?
4. Are owls using created habitats inside and outside DCAs? What specific structural conditions are being used by owls and for what functions?

Validation monitoring/research questions.

Dispersal studies.

1. How well do various habitat conditions provide for dispersal of owls?
2. How well do various spacing distances among DCAs provide for dispersal of owls?
3. What is the type of use and relative degree of use of various habitat conditions by dispersing owls?

Spotted owl ecological relationships and population dynamics.

1. What is the range of forest structural conditions used by owls? How do owls use those conditions and what is the relative degree of use?
2. What are the specific stand features that influence the type and degree of owl use? These may include forest structure, species composition, amount and distribution of coarse woody debris, and number and distribution of snags.
3. How are owl reproductive success and survivorship related to habitat conditions, amount, distribution, and rate of change?
4. How are owl reproductive success and survivorship related to local population size?

Owl habitat relationships and management.

1. What is the influence of various management practices on forest stand composition and structure?
2. How do individual owls respond to management practices and resulting stand conditions within home ranges?
3. How do owl populations respond to management practices and resulting stand conditions within landscapes composed of multiple home ranges?
4. What are efficient and repeatable techniques for assessing habitat conditions at the stand and landscape scale?

Economics.

1. What are the costs and returns of various silvicultural practices that could be used to develop or sustain suitable habitat conditions?
2. How would various types of incentive systems operate to encourage land-owner contribution to recovery?

Owl prey; prey relationships; and competitive relationships.

1. How do owl diets influence owl survivorship and reproductive success?
2. What are the patterns of abundance of principal prey species? How are they related to habitat conditions?
3. How do prey species respond to management practices and resulting stand conditions within owl home ranges?

4. What are the population dynamics patterns of principal prey species, and how are they influenced by habitat?
5. What are movement and dispersal patterns of prey species?
6. How do different habitat conditions affect competitive relationships between barred owls and spotted owls?

To facilitate the validation monitoring/research needed for adaptive management, the Recovery Team recommends that additional research areas be set-up near established demographic study areas within the federal matrix. The demographic study areas are described later. One research area per province would be desirable, and its area should be equivalent to its companion demographic study area. The Recovery Team recommends that these research areas have as their goal replicated experiments to evaluate 1) the response of owls to timber harvest, 2) the utility of various silvicultural prescriptions in producing habitat for owls, 3) emigration and immigration rates in response to a changing landscape, and 4) the demographic response of the owl population within the area. Experiments in these research areas can occur in currently suitable habitat, and will contribute to the objective of the recovery plan to delist the owl across its range and to achieve forest silviculture that is compatible with owls across the landscape. Inferences regarding the compatibility of timber harvest with owls can be achieved only through the execution of controlled, replicated experiments. It is essential that the principle investigators of the companion demography and experimental research areas agree to full cooperation before establishing the research protocol on the experimental areas.

The Recovery Team also recommends that research continue on the Yakima Indian Nation land and on private land throughout the range of the owl. Ongoing research on Yakima land is a unique study of owl population responses to a forested landscape that has been managed through an uneven-aged silvicultural regime.

Adaptive Management Procedures

To realize the objectives of the monitoring and research program, there must be a process in place that will guide how the results of the program will be used. This process must include agreement on specific monitoring and research results that will trigger review and possible revision of the recovery plan. Such reviews could take place as part of a review cycle for the recovery plan or at any other time. The Recovery Team strongly recommends that such trigger points be developed for at least the following potential actions:

1. Determine when it would be appropriate to modify DCA boundaries based on owl numbers or suitable habitat availability that fall below or above projections.

If numbers of owls or amounts of suitable habitat are found to be above predicted levels in one or more DCAs, it may be appropriate to either reduce the size of those DCAs or to allow greater flexibility of management within them (see the next potential action). However, it first should be determined that the high populations are not the result of "packing" phenomena (Thomas et al. 1990) and that the proposed management has been demonstrated to produce desired habitat conditions for owls. Review of any individual DCA should be done within the context of an entire province to ensure that a key source area is not weakened. If one or more DCAs are below objective levels, it may be necessary to modify DCA boundaries and possibly increase their size or the quality of habitat within the DCA boundary. In this case, it first should be determined that the low numbers of owls are not related to short-term demographic responses. Finally, it may be appropriate to eliminate DCA boundaries

when the population of owls in the matrix is at the level of those found in the DCA, their demographic rates are similar to those in DCAs, and forest management has been demonstrated to be compatible with the owls.

2. Determine when it would be appropriate to broaden management recommendations within DCAs based on 1) achievement of stable, self-sustaining numbers of owls or amounts of suitable habitat that exceed predictions, 2) demonstrated success of management activities in providing for owls, or 3) demonstrated need to reduce likelihood of large-scale disturbances.

The recovery plan recommends that some forms of salvage be allowed within DCAs and that some limited attempts begin to use management to improve habitat and to decrease the risk of disturbance. Monitoring both the implementation and effectiveness of these activities is crucial because they will influence the capability of the DCAs to support owls. As monitoring adds to knowledge about the use of management practices in DCAs, it may be useful to increase and broaden application of those practices. If management is demonstrated to be useful in developing younger, currently unsuitable stands, the use of such management should be encouraged beyond the levels established in this plan. If management is shown to be useful in older stands, recommendations may be broadened to include those stands. If owl numbers or amounts of suitable habitat exceed predictions, it may be useful to define a core area of the DCA that would continue to be managed under current guidelines and additional areas that would be managed with fewer restrictions on the use of silviculture, salvage, and other management options. Finally, if the ability to maintain suitable habitat while reducing the risk of large-scale disturbance is demonstrated, such activities should be encouraged within DCAs that are at high risk.

3. Determine when it would be appropriate to end special management for reserved pair areas based on improved conditions in individual DCAs or groups of DCAs.

The recovery plan recommends that additional pair areas be established where the DCA system is currently deficient. If those deficiencies are corrected, it may be appropriate to modify management within those pair areas.

4. Determine when it would be appropriate to supplement or modify the DCA system based on unexpectedly poor performance of owl populations (i.e., survival rates, fecundity rates, and immigration rates).

The monitoring and research program will provide data on the population dynamics of owls within the DCA system. If it becomes clear that populations are not replacing themselves within these areas, or that immigration is not occurring as expected among areas, one of the following actions may be appropriate:

- a. Modify DCAs where possible to include any contiguous areas of high owl concentrations and habitat with low levels of fragmentation.
 - b. Add new DCAs to the system, emphasizing areas of high owl concentration and high quality habitat.
 - c. Add new DCAs to the system with the primary objective of reducing the dispersal distance among DCAs.
 - d. Modify the recommendations for management within DCAs.
5. Determine when it would be appropriate to modify matrix management recommendations based on impending isolation of DCA subpopulations determined through unexpectedly low rates of movement among DCAs.

If the monitoring and research program shows unexpectedly low rates of movement among DCAs, or provides new knowledge of limited dispersal of owls in various forest types, it may be necessary to either supplement the DCA system (see earlier recommendation) or change the management of the matrix.

6. Determine when it would be appropriate to modify matrix management recommendations based on information that owls disperse successfully through habitats of smaller trees and lower canopy closure.

If the monitoring and research program shows high rates of successful dispersal through forests with small trees and/or low quality habitat, it may be appropriate to relax recommendations for dispersal habitat.

Primary Information Needed for Delisting Northern Spotted Owl Populations

The criteria for delisting are explained in section III.A. They are 1) that owl populations and habitat be monitored with a scientifically credible plan, 2) that the population be stable or increasing, 3) that commitments be in place to provide long-term protection of habitat, and 4) that information from a variety of sources indicates that the population will not need renewed protection under the Endangered Species Act. The following section describes the hypotheses that must be tested to satisfy delisting criteria 2 and 4 and the specific information that must be collected to test those hypotheses.

Delisting Criterion 2: *The population has been stable or increasing during at least the last 8 years, as indicated by both density estimates and demographic analyses, in all parts of the area that would be considered significant under the Endangered Species Act.*

Hypothesis 1

The change in total number of territorial owls over time is greater than or equal to zero.

Information needed to test hypothesis 1

An estimate or index of the number of territorial owls repeated over time is needed. At a minimum, there must be an adequate estimate made for each physiographic province. Estimates over smaller geographic areas should be made if those areas would be considered significant under the Endangered Species Act. Within the provinces, the estimate should be stratified into DCAs and forestlands outside DCAs. These separate estimates then must be combined into a single estimate for the entire province.

Hypothesis 2

The finite rate of increase of owl populations is greater than or equal to zero as determined from estimates over time of demographic parameters.

Information needed to test hypothesis 2

Estimates over time of age-specific or stage-specific survival and reproduction rates, including age at first and last reproduction, are required. Estimates should be made for at least one subpopulation within each physiographic province, with the subpopulation sufficiently large to produce statistically reliable estimates of the demographic parameters. Estimates for additional subpopulations may be necessary to fully represent the range of ecological conditions within each province.

Delisting Criterion 4: *The population is unlikely to need protection under the Endangered Species Act during the foreseeable future.*

Hypothesis 1

Long-term demographic projections, that include the effects of fluctuations in abundance, fecundity, and survivorship, indicate that there is a high probability of persistence of the population for 100 years.

Information needed to test hypothesis 1

The data collected to answer questions about population and demographic trends over time can be used in a modeling context to respond to this hypothesis. It is important to emphasize that, within the context of metapopulation dynamics, some DCA subpopulations may decline for a variety of reasons (e.g., catastrophic events, random demographic events) even when the metapopulation is stable. Therefore, delisting could occur in the province if the metapopulation as a whole were stable even though some DCAs would not be contributing fully for short periods.

Hypothesis 2

There are sufficient immigrants per generation among DCAs to maintain demographic stability and genetic diversity.

Information needed to test hypothesis 2

Data are necessary for the number of immigrants per generation into DCAs. These data can be collected best in conjunction with the studies of demographic rates.

Hypothesis 3

Changes in amount and distribution of northern spotted owl habitat occur at expected rates and result from expected causes.

Information needed to test hypothesis 3

Estimates over time of amounts and distribution of various classes of habitat are needed. These estimates must account for the development of suitable conditions on some areas and the loss of suitable conditions on others.

The Recovery Team makes the following recommendations for study areas and techniques for collection of information needed for delisting.

Demography. Demographic study areas will provide information on demographic (i.e., vital) rates (e.g., age-specific, stage-specific rates of fecundity and survival, age at first and last reproduction) and the occurrence of immigration. These are large areas, tens to hundreds of square miles, where as many owls as possible are banded. Banding is done on adult, subadult, and juvenile owls. Owls are observed on an annual basis on territorial sites, and young are observed annually on nest sites. These observations are used to determine age-specific or stage-specific fecundity and mortality rates. Procedures for developing some of these estimates are explained further in Appendices A and C. There are currently seven demographic study areas which should form the basis for assessments of demographic trends within their respective provinces. These study areas are located in the following provinces: Olympic Peninsula; eastern Washington Cascades; western Oregon Cascades; Oregon Coast; and California Coast. An additional demographic area should be established in the western Washington Cascades. Three provinces — western Washington

lowlands, eastern Oregon Cascades, eastern California Cascades — currently cannot support demographic studies equivalent to those found in the other provinces because of low owl numbers. Density and demographic studies could be initiated in these provinces when their owl populations have increased to the point that delisting can be considered.

General recommendations for demographic studies are as follows:

1. Maintain existing demographic study areas. Since owls are long-lived animals, long duration population studies will be necessary to estimate population trends. Assessment of annual changes in vital rates is necessary to draw appropriate inferences from the study. The most cost-effective way to evaluate owl populations is to continue the demographic studies. The longer a study has existed the more valuable it is for assessing trends in demography.
2. Expand demographic study areas to include larger areas that will encompass owls within several DCAs and the province matrix. This will allow some estimation of immigration into DCAs. While this will not allow an absolute estimate of the number of immigrants, it will provide evidence that immigration is occurring and it will provide estimates of the sources of the immigrants and distances traveled. Such large study areas encompassing the demography study areas also would improve the analysis of regional trends in demography.
3. Monitor demographic trends in both the matrix and the DCA network within each province. Franklin and Gutiérrez (unpub. data) indicate that individual owl pairs monitored throughout the California Klamath province have the same (i.e., not statistically different) vital rates as a population of contiguous owls in the Willow Creek demographic study area. The cost for this monitoring is minimal and could be conducted in conjunction with the current demographic studies (Appendix A).

Owl population trends. Numerical trends of owls should be monitored in the matrix and DCA network within each province. Several methods have been developed to estimate numerical and density estimates for owls including transect sampling (Forsman et al. 1977), capture-recapture models, empirical estimation, quadrat sampling (Franklin et al. 1990b), and catch per unit effort models (Ward et al. 1991). Additional sampling procedures are presented in Appendix A.

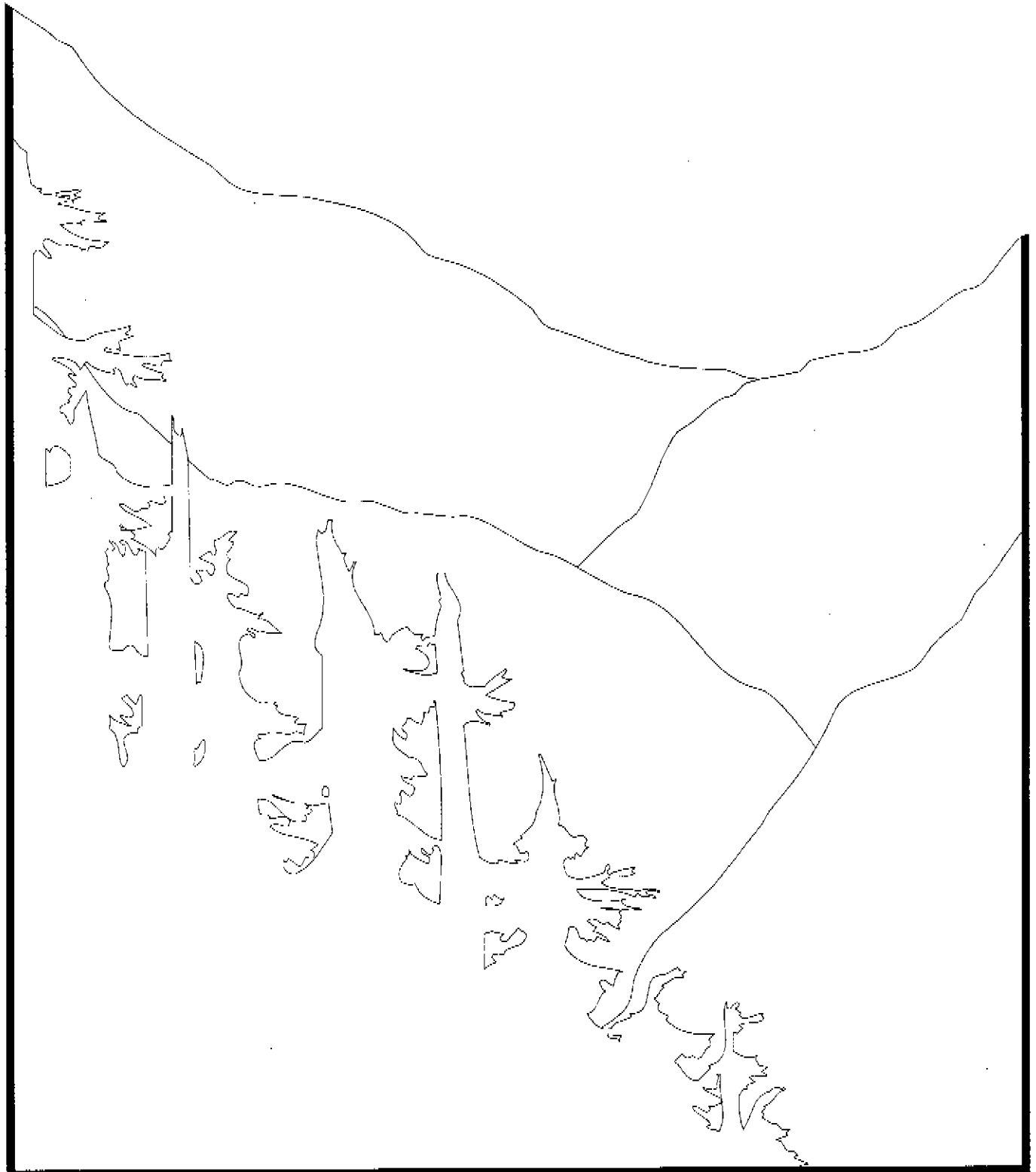
Population Modeling. Mathematical modeling is a powerful tool for assessing population dynamics. The Recovery Team recommends that the development of models, such as those produced by scientists at the Forest Service Redwood Sciences Laboratory, continue.

Coordination

The monitoring and research effort must be coordinated among the responsible federal agencies and state agencies, and private interests, including universities. This coordination should be part of the function of the coordinating group established during the implementation of this plan (see section III.C.5). The coordinating group will help ensure that all required parts of the monitoring program are conducted; that monitoring designs are coordinated among agencies and landowners; that the monitoring proceeds according to design; that monitoring reports are prepared and reviewed on an established schedule; that periodic reviews are made to see if management adjustments are needed or desirable; and that recommended research activities are coordinated among agencies so that research is efficient and representative of the entire range of the subspecies.

Chapter IV

Implementation Schedule



IV.

The narrative and implementation schedule that follow outline actions and estimated costs for the recovery program. This chapter is a guide for meeting the objective discussed in the plan. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified and, therefore, this reflects the total estimated financial requirements for the implementation of the plan for recovery of this species. This section summarizes only direct agency costs of achieving recovery. Indirect costs such as lost employment are discussed in Appendix H.

1993 Estimated Funding Amounts

BLM:

\$7,000,000; including research, inventory, monitoring, habitat improvement survey and studies, and other necessary related efforts, as well as funds in the wildlife habitat program.

FS:

\$8,917,000 (est.) including research (\$2,917,000), and management (\$6,000,000).

BIA:

\$1,700,000, including surveys, biological assessments and consultation, design, implementation, and monitoring of special silvicultural and harvest methods.

FWS:

\$2,760,000, including funding to support the recovery team, evaluate and designate critical habitat, public information, consultation, education, law enforcement, and research.

NPS:

\$1,500,000, including intensive surveys to establish baseline population, monitoring, demographic and habitat studies, habitat use, and program coordination.

NOTE Priorities on implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.
Key to Acronyms used in Implementation Schedule

BIA - USDI Bureau of Indian Affairs
BLM - USDI Bureau of Land Management
FS - USDA Forest Service
FWS - USDI Fish and Wildlife Service
NPS - USDI National Park Service
RT - Recovery Team (or the coordinating group recommended in the plan)
SA - State Agency
UNIV - University (Humboldt State, Oregon State, Washington State, etc.)

Stepdown Outline

1. Management Tasks.
 11. Review recovery plan.
 12. Establish coordination group.
 13. Implement recommendations regarding DCAs.
 131. Establish DCAs.
 132. Prepare guidelines for activities in DCAs.
 133. Prepare DCA management plans.
 1331. Prepare demonstration plans.
 1332. Prepare remainder of plans.
 1333. Implement DCA plans.
 14. Manage the federal matrix.
 141. Implement Prescription A.
 1411. Establish residual habitat areas.
 1412. Implement residual area management guidelines.
 1413. Implement "50-11-40" guideline.
 142. Implement Prescription B.
 1421. Establish reserve pair areas.
 1422. Implement reserve pair management guidelines.
 143. Implement Prescription C.
 1431. Establish managed pair areas.
 1432. Implement managed pair guidelines.
 144. Implement Prescription D as appropriate.
 1441. Evaluate potential contribution of Prescription D to recovery.
 1442. Implement Prescription D where it will contribute to recovery.
 15. Manage non-Federal lands.
 151. Establish measurable goals.
 152. Develop plans to meet goals.
2. Regulatory mechanisms.
 21. Propose formal adoption of the recovery plan.
 22. Revise existing regulatory measures as appropriate.
 221. Revise critical habitat boundaries to follow DCA boundaries.
 222. Revise or amend land management plans.
 23. Enforce taking prohibition.
 24. Publish regulations interpreting taking prohibitions.
 25. Advise owners and managers of land.
 251. Provide guidance on programmatic consultation.
 252. Conduct consultations regarding federal actions.
 253. Provide technical assistance to non-federal landowners.
 2531. Assist States in developing protective management plans.
 2532. Assist private landowners in developing Habitat Conservation Plans.
 2533. Assist with spotted owl studies and surveys.
 2534. Evaluate potential usefulness of special rules.
3. Land Acquisition.
 31. Evaluate opportunities for land exchange, easement, or purchase.
 32. Acquire land or interest in land through exchange, easement, or purchase.
4. Research and Monitoring.
 41. Maintain and refine GIS.
 42. Implement monitoring program.
 421. Agree on objectives and methods.
 422. Conduct roadside surveys.
 4221. Design surveys.
 4222. Carry out surveys.

-
-
- 423. Monitor activity sites.
 - 4231. Estimate sample size.
 - 4232. Carry out monitoring.
 - 424. Study demographic analyses.
 - 425. Study population models.
 - 426. Develop early warning methods.
 - 43. Study habitat suitability.
 - 431. Standardize habitat measurements.
 - 432. Prepare habitat maps for demographic study areas.
 - 433. Study suitability in selected areas.
 - 4331. Study California coast.
 - 4332. Study eastern California.
 - 4333. Study eastern Cascades.
 - 434. Evaluate suitability of selected habitats.
 - 4341. Evaluate young plantations with remnant larger trees.
 - 4342. Evaluate stands managed with selective harvest.
 - 4343. Evaluate areas in which salvage is economically feasible.
 - 44. Conduct demographic studies.
 - 441. Continue well-established studies.
 - 442. Consider need for additional studies.
 - 443. Initiate new studies as appropriate.
 - 5. Review and Evaluation.
 - 51. Prepare reports.
 - 511. Prepare annual progress reports.
 - 512. Prepare 5-year evaluation report.
 - 52. Review recovery plan and revise as appropriate.

Table 4.1 Abbreviated Cost Table

The following table identifies estimated costs by broad category from the stepdown outline for the federal agencies. More detailed cost estimates will be incorporated into the implementation schedule before approval of the final recovery plan.

Cost Category	Agency	Estimated Cost (x1000)		
		FY93	FY94	FY95
1. Management Tasks	BLM	4,100	10,800	12,000
	BIA	425	25	25
	FWS	800	1,000	1,000
	FS	2,230	3,800	4,200
	NPS	70	100	100
2. Regulatory Mechanisms	BLM	590	1,500	750 ¹
	BIA	325	325	300 ¹
	FWS	1,260	1,500	1,200 ¹
	FS	1,690	2,800	500 ¹
3. Land Acquisition ²				
4. Research and Monitoring	BLM	2,100	5,250	5,250
	BIA	900	900	900
	FWS	600	600	600
	FS	4,727	7,900	8,200
	NPS	1,400	1,500	1,600
5. Review and Evaluation	BLM	210	500	500
	BIA	50	50	50
	FWS	100	100	100
	FS	270	500	800
	NPS	30	50	50
Totals	BLM	7,000	18,050	18,500
	BIA	1,700	1,700	1,675
	FWS	2,760	3,200	2,900
	FS	8,917	15,000	13,700
	NPS	1,500	1,650	1,750

¹ Reduced regulatory expenditures in FY 95 are based on the expectation that programmatic consultation will be instituted.

² Costs in this category cannot be estimated pending completion of agency management plans.

Table 4.2. Implementation Schedule

Task Priority	Task	Task No.	Duration (years)	Resp. Party			Cost Est. (x\$1000)		
				Reg.	FWS Prog.	Other	1993	-94	-95
1	Establish DCAs	131	2			FS BLM NPS			
1	Establish residual	1411	1			FS BLM			
1	Implement 50-11-40	1413	cont.			FS BLM			
1	Establish reserve pair areas	1421	1			FS BLM			
1	Implement reserve pair management guidelines	1422	1			FS BLM			
1	Establish managed pair areas	1431	1			FS BLM			
1	Implement managed pair guidelines	1432	1			FS BLM			
1	Propose formal adoption of plan	21	1	1	FWE	FS BLM NPS			
1	Enforce taking prohibition	23	cont.	1	LE				
2	Establish coordin- ation group	12	1	1	FWE	FS BLM NPS CA OR WA			
2	Implement residual area guidelines	1412	cont.			FS BLM			
2	Establish non- federal goals	151	1			CA OR			
2	Develop nonfederal plans	152	2			CA OR WA			
2	Revise or amend federal plans	222	1			FS BLM			
2	Review and revise plan	52	1						
3	Review plan	11	1	1	FWE				
3	Prepare DCA guidelines	132	1			FS BLM NPS			
3	Prepare demo plans	1331	1			FS BLM NPS			
3	Prepare remaining plans	1332	2			FS BLM NPS			

continues—

continued—

Task Priority	Task	Task No.	Duration (years)	Resp. Party			Cost Est. (x\$1000)		
				Reg.	FWS Prog.	Other	1993	-94	-95
3	Implement DCA plans	1333	cont.			FS BLM NPS			
3	Evaluate prescription D	1441	1	1	FWE	FS BLM NPS			
3	Implement prescription D as appropriate	1442	cont.			FS BLM			
3	Revise critical habitat boundaries	221	1		FWE				
3	Publish take	24	1	1	FWE				
3	Provide guidance on programmatic consultation	251	1	1	FWE				
3	Conduct consultation	252	cont.	1	FWE	FS BLM NPS			
3	Assist states in planning	2531	cont.	1	FWE				
3	Assist private planning	2532	cont.	1	FWE				
3	Assist with studies and surveys	2533	cont.	1	FWE				
3	Evaluate special rules	2534	1	1	FWE				
3	Evaluate acquisition opportunities	31				FS BLM NPS CA OR WA			
3	Acquire land as	32				FS BLM NPS CA OR WA			
3	Maintain GIS	41	cont.			RT	50	50	50
3	Agree on objectives and methods for monitoring	421	1	1	FWE	RT FS BLM NPS CA OR WA			
3	Design roadside surveys	4221	2			RT			
3	Carry out roadside surveys	4222	cont.			FS BLM NPS CA			

continues—

continued—

Task Priority	Task	Task No.	Duration (years)	Resp. Party FWS			Cost Est. (x\$1000)		
				Reg.	Prog.	Other	1993	-94	-95
3	Estimate sample	4231	1			OR			
3	Carry out	4232	cont.			WA	2	1	
	monitoring					RT			
						FS			
						BLM			
						NPS			
						CA			
						OR			
						WA			
3	Study demographic	424	3			RT			
	analyses					FS			
						BLM			
3	Study population	425	3	1	FWE				
	models					RT			
						FS			
						BLM			
						NPS			
3	Develop early	426	cont.			RT			
	warning methods								
3	Standardize	431	1			RT			
	habitat								
	measurements								
3	Prepare habitat	432	2			RT			
	maps					FS			
		BLM							
3	Study habitat	433	3			RT			
	suitability					FS			
	in selected areas					BLM			
3	Study suitability	434	3			RT			
	of selected					FS			
	habitats					BLM			
3	Continue willow	4411							
	creek study								
3	Continue Roseburg	4412							
3	Consider new	442	1			RT			
	demography studies					FS			
		BLM							
3	Initiate new	443	cont.			RT			
	demography studies					FS			
						BLM			
3	Prepare annual	511	cont.			FS			
	reports					BLM			
						NPS			
						BIA			
						CA			
						OR			
						WA			
3	Prepare 5-year	512	1			FS			
	report					BLM			
						NPS			
						BIA			
						CA			
						OR			
						WA			

Chapter V

Consideration of Other Species

